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ABSTRACT

The environmental education curriculum in this package emphasizes biological diversity. The curriculum contains 10 units--each dealing with a specific concept relating to biological diversity. Each unit contains hands-on activities designed to make children aware of the importance of maintaining a biologically diverse world. Some activities are best suited for use at the school site prior to a visit to a park area. These activities are then reinforced by activities conducted in the park. There are further activities that can be used in the classroom after students return from the park. Units include: (1) "Biodiversity: The Spice of Life"; (2) "Extinction Is Forever"; (3) "The Role of National Parks in Maintaining and Preserving Biological Diversity"; (4) "Biological Diversity: Its Value in $$$ and Sense"; (5) "Biodiversity: Considering the Global Connections"; (6) "Habitat and Niche"; (7) "Organisms/Populations of Organisms"; (8) "Adaptation/Change"; (9) "Communities"; and (10) "Biodiversity at Historic and Cultural Sites." Three levels of biological diversity are explored: ecosystem, species, and genetic. Each unit contains an overview, table of contents, teacher background, pre-visit activities, on-site activities, post-visit activities, evaluation, resources, and blackline masters. Each activity includes the objectives, materials, and procedure. (KR)

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BIOLOGICAL DIVERSITY

Makes a World of Difference

A Curriculum for Teachers and Interpreters

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National Park Service
Minnesota Environmental Education Board
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Passport to Your National Parks Program

FOREWORD

Dear Teacher and Interpreter:

Crows, jays, warblers, pelicans, sparrows, ducks, eagles—all different varieties of birds. Lions, tigers, bears, mice, rabbits, dogs—all different varieties of mammals. Maples, elms, pines, palms, oaks—all different varieties of trees. These you can see, but there are thousands of different varieties of micro-organisms that are the beginning of the food chain for the animals, birds and plants that you can't see. The earth abounds with variety. Almost anywhere you travel you will find an incredible variety of plants and animals. This variety of life is called biological diversity. It includes ecosystems and their interacting communities of plants, animals, and micro-organisms, as well as species, and their genetic composition and variation.

Why is biological diversity important? Why should we care about preserving as much of it as possible? Our lives, and life on earth as we know it, are dependent upon the complicated inter-actions and interdependency of the myriad species of life forms with which we share this planet. Ecosystems are composed of both living and non-living elements. Control of climate and the quality of the atmosphere are services provided freely by natural ecosystems. So too are the cycling of nutrients and the natural disposal of wastes, pollination and the supply of foods, the maintenance of soils, and water storage in forest watersheds.

This renewal and recycling process is the power nature has to cleanse and rebuild ecosystems, but there is a balance that must be maintained and, as good stewards, we must maintain species of plants and animals that affect our lives everyday and in ways few people realize. Foods that we eat, medicines we take for illnesses, industrial products we use, and pets and house plants, may all owe their origin to living wild plants and animals. Developed and developing countries alike are dependent upon a species richness embodied in a common, shared heritage of biological diversity. It has been stated that the loss of biological diversity is second only to nuclear warfare in its threat to human and other life on this planet. This loss of the diversity of life, and other related environmental concerns, may well be the most significant issue facing mankind as we approach the beginning of the 21st century. As the 20th century ends, we face the loss of many species which were present at its beginning.

A critical part of the problem is that we just don't know how many species of living plants, animals, and micro-organisms there are. A few years ago five to six million would have been a common estimate. Today, a conservative estimate would be thirty million plus. When you don't know how much there is of something, you can't accurately assess what you're losing. The tropical areas of the world contain the greatest biological diversity, and it is there where the greatest loss of plants, animals and micro-organisms is occurring.

The threats to biological diversity include the loss of places where plants and animals naturally grow; pollution; direct elimination of animal and plant species; introduction of alien species; and climate change, especially global warming. Our hope—the earth's hope, lies in a concerned, educated, and motivated public. It begins with education. Hence, we are happy to endorse and support this environmental education curriculum on biological diversity. The future is in our hands, our hearts, our minds.

James M. Ridenour
Director
National Park Service

Paul C. Pritchard
President
National Parks and Conservation Association

ABOUT THIS CURRICULUM

The National Park Service (NPS) has declared biological diversity a Service-wide initiative. National parks often provide the last stronghold for many species of plants and animals. Recognizing this, former National Park Service director, William Penn Mott, Jr. created a task force to determine what the Service could do to preserve and maintain the variety of life. The task force found that there is a great deal of misunderstanding about what biological diversity is, as well as a lack of awareness of its importance. Educating the public was identified as a first step in preserving biological diversity.

The National Parks and Conservation Association, a national environmental organization, saw the need for educational materials about national parks geared to children. Responding to the task force's recommendations, the Minnesota Environmental Education Board, NPCA and the National Park Service decided to develop a curriculum on biological diversity. The Passports to Your National Parks Program was crucial to the funding of this effort.

Designed especially for children in the fourth through the sixth grades, the curriculum contains ten units—each dealing with a specific concept relating to biological diversity. Each unit contains hands-on activities designed to make children aware of the importance of maintaining a biologically diverse world. Some activities are best suited for use at the school site prior to a visit to a park area. These activities are then reinforced by activities conducted in the park. There are further activities that can be used in the classroom after students return from the park. We encourage the adaption of the material to make it fit each special circumstance and need.

AN OVERVIEW OF THE UNITS

1. BIODIVERSITY: THE SPICE OF LIFE

Participants hunt for and investigate biological diversity. Three levels of biological diversity are explored: ecosystem, species and genetic. The emphasis throughout is on species diversity—the variety of life.

2. EXTINCTION IS FOREVER

Through guided imagery, questionnaires, research projects, and games in the classroom and in the field, students learn about the process of extinction and the role of human beings in the process.

3. THE ROLE OF NATIONAL PARKS IN MAINTAINING AND PRESERVING BIOLOGICAL DIVERSITY

Students learn about the role of national parks in preserving biodiversity through process oriented investigations, planning, discussion and writing to students near another national park.

4. BIOLOGICAL DIVERSITY: ITS VALUE IN $$$ AND SENSE

Students learn how we use wild plants and animals to produce the material objects which sustain and enrich human life. They do this through research, games and interpretive activities.

5. BIODIVERSITY: CONSIDERING THE GLOBAL CONNECTIONS

Students learn how we depend on and affect the world's stock of plants and animals. They do this through original explorations, participatory games and creative dramatics.

6. HABITAT AND NICHE

Through investigations of commonly found organisms and games in the classroom and field, students learn about the importance of habitat and niche in preserving biological diversity.

7. ORGANISMS/POPULATIONS OF ORGANISMS

Children search for organisms in their schoolyard/neighborhood to find out what lives and grows there. They determine how many organisms there are in a study site. Children participate in games designed to help them understand variation in organisms and population changes. They make value decisions about plant/animal issues. Children play a game and learn some of the factors involved in the endangerment/extinction of small populations.

8. ADAPTATION/CHANGE

In this collection of activities students learn about the concept of adaptation. Through time, plants and animals become marvelously fitted to their environments. However, human activities are dramatically changing the earth's environments. Many plants and animals are unable to keep up with these changes and are threatened with extinction. Students learn about adaptation through creative invention, interpretive experiences, exploration of animal coverings and a game based on a popular television program.

9. COMMUNITIES

In these activities students learn about plant and animal relationships in communities, how humans can change these relationships, and their effects on biological diversity. Students play a community game in which they turn their classroom into a community. At the park they participate in decision making activities and learn why we should save all the parts of a community. When they return to the classroom students decide which uses of a community are most important and evaluate possible actions humans might take as they attempt to solve a problem of coexistence with dangerous wildlife.

10. BIODIVERSITY AT HISTORIC AND CULTURAL SITES

Culture and nature are intimately interconnected. In these activities youngsters make a biological diversity booklet on the variety of ways early people used plants and animals. They make a time line that includes historical and biological diversity events. At a cultural site they explore uses and abuses of biological diversity. Back in the classroom, they study symbols of biodiversity chosen by their state.

THE MAP

The cover graphic and the maps within this guide are based on the Peters Map of the World. This map is the work of German historian, Arno Peters. Though it too is distorted in its translation of the earth's spherical shape onto a flat surface, this projection corrects the proportional distortions of other maps which are based on information laid down hundreds of years ago when Europe dominated and exploited the earth. This new map shows all the continents and oceans according to their actual size and distance from the equator.

For more information on this map and extended interpretation, see *The New Cartography*, Carinthia University Press, Klagenfurt, Austria, and Friendship Press, New York, USA, 1983.

FOR FURTHER INFORMATION

If you want to help *make a world of difference* contact:
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or the National Park area closest to you.

Copies of this biological diversity curriculum can be purchased from:
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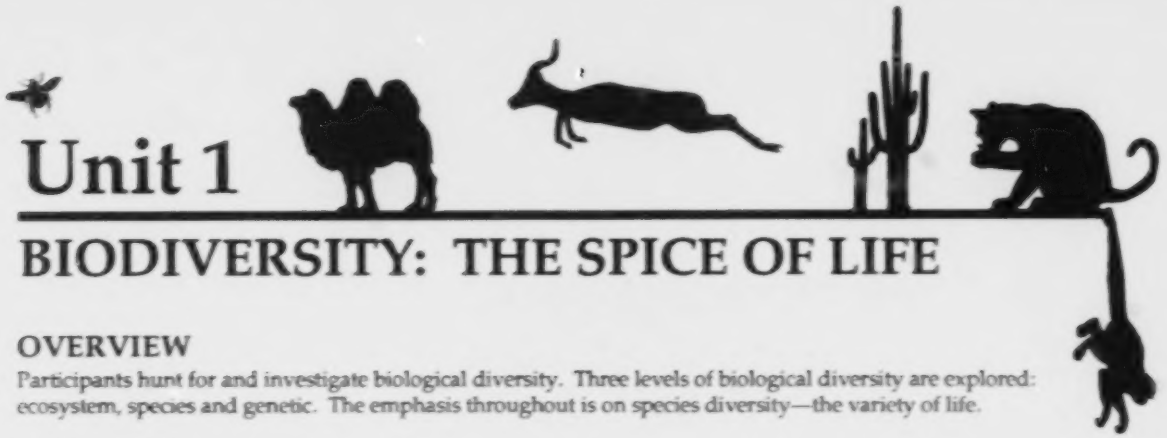

Unit 1

BIODIVERSITY: THE SPICE OF LIFE

OVERVIEW

Participants hunt for and investigate biological diversity. Three levels of biological diversity are explored: ecosystem, species and genetic. The emphasis throughout is on species diversity—the variety of life.

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TEACHER BACKGROUND

Biological diversity or biodiversity refers to the variety and variability of living organisms on the planet. Ecologists tend to focus on three levels of biological diversity: genetic, species, and ecosystem diversity.

Species diversity is the most common level of diversity. Species is a word used in biology to refer to a type of organism different from all others. Species diversity is a measure of the number of species at a location. It varies greatly from place to place.

Ecosystem diversity is a complex level of biological diversity. An ecosystem is a system in which a community of organisms and their physical environment interact. Each ecosystem (e.g., a park) contains characteristic plants and animals. Some examples of ecosystems are grasslands, deserts, rain forests, conifer forests, and deciduous forests. In a large area there may be several different ecosystems. This is ecosystem diversity.

Genetic diversity is a less obvious level of biological diversity. Genes are inherited from parents and transmitted to offspring. Genes affect how organisms look and how they work. Genes also make each individual at least a little different from every other member of the species. These differences are what we call genetic diversity.

Today there is great concern about the loss of biodiversity. In the foreword to Technologies to Maintain Biological Diversity, John H. Gibbons, Director of the Office of Technology Assessment states, "The reduction of the Earth's biological diversity has emerged as a public policy issue in the last several years. Growing awareness of this planetary problem has prompted increased study of the subject and has led to calls to increase public and private initiative to address the problem.

"One major concern is that loss of plant, animal, and microbial resources may impair future options to develop new important products and processes in agriculture, medicine, and industry. Concerns also exist that loss of diversity undermines the potential of populations and species to respond or adapt to changing environmental conditions. Because humans ultimately depend on environmental support functions, special caution should be taken to ensure that diversity losses do not disrupt these functions. Finally, esthetic and ethical motivation to avoid the irreversible loss of unique life forms has played an increasingly major role in promoting public and private programs to conserve particular species or habitats."

SECTION I. CLASSROOM—PRE-VISIT ACTIVITIES

Activity 1. Make a Graph of Biological Diversity: Species (or kind)

OBJECTIVES

Students will be able to
1) explain the concept of biodiversity/biological diversity; and
2) group living things by observable attributes.

MATERIALS

For the Class

Community-Environment sample: several shovelfuls of a forest or a meadow/prairie/lawn or mud from a pond in a large bucket. If possible, the samples should contain both plants and animals, including plant and animal remains.
Shovel
Bucket
Newsprint/butcher paper
Optional: Water, if you use mud.

For Each Group

1 Egg carton
3 Plastic spoons
1 Plastic tray
1 Large plastic cup
3 Magnifiers
Pencils and paper
1 Ruler
Newspaper
Tape
Optional: Plastic cup for water if a mud community is used

For Each Student

Blackline Master: SPICESHEET I

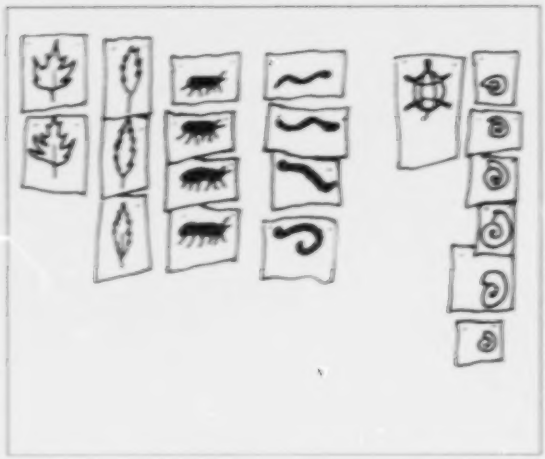
PROCEDURE

1. Separate children into groups of two or three. Have each group place a couple of sheets of newspaper on their work surface and take a large scoop of the community-environment you have chosen for them to study. After the activity, please return the sample to the location from which you took it.

2. Have the students carefully sort through their samples and remove each organism. Organisms of the same kind should be placed together in the same partition of the egg carton. If your class is using a sample of mud add a few spoonfuls of water to each partition used. Plants, if any, can be laid on the newspaper.

3. Have each team complete SPICESHEET I.

4. Make a graph showing the diversity. Use the drawings to make a picture graph. Have one member of a team take one of their pictures and tape it in the upper left hand corner of the board. Have a member of the second team select one of their pictures. If it is similar to the one on the board, tape it below, if it is different, tape it to the right to make a new column. Continue until all the pictures are on the board.



This is a graph of species diversity. It shows how many kinds of organisms were found, as well as how many of each kind were found.

5. Ask the following kinds of questions:
- Which column has the most?
- Which column has the least?
- Which plant or animal did we find most often?
- Which plant or animal did we find least often?
- Are there more _____ than _____?
- Are there any columns which are the same?
- Are there any columns which show the same number of plants and animals?
- If you made two graphs do the two graphs have the same general shape?
- How many more _____ are there than _____?
- How many less _____ are there than _____?
- How many different kinds of organisms altogether?
- What is the total number of organisms we found?
- Did we find more plants or animals?

6. Gather the class together for a discussion. Ask students if they know a special scientific word used to express the different kinds of plants and animals. That word is DIVERSITY. Write it on the board.

Tell students that there is also another term used to represent plant and animal diversity. Write BIOLOGICAL DIVERSITY on the board. It refers to the great variety of different kinds of plants and animals on planet Earth. Write BIODIVERSITY on the board too, and tell students that this is a shorter way of writing this. They should know both because they will hear them at zoos and in park programs as well as on television and magazines. If you want, tell students that the "bio" in biological refers to life and the "ological" ("ology") refers to the study of life.

7. Ask students to list as many different animals as they can. Write ANIMALS on the board and list the names that students mention.

8. Ask students to list as many different plants as they can. Write PLANTS on the board and list the names that students mention.

9. Discuss these lists by using the following kinds of questions:

- Which group has the most?
- What do we appear to know about biological diversity?
- What biological diversity do we appear to be interested in?
- Are there more wild animals than other animals listed? Plants?
- What is a wild animal? Plant?
- Are there more trees than garden plants?
- Rank order the different kinds of animals from most to least. (You may want to write Insects, Birds, Wild Animals, Pets, Farm Animals and Other on the board and have students rank order them from most to least.)
- In what surroundings (or habitats) would you find _____? (Have students describe these places in terms of characteristics such as precipitation, temperature, and seasons.)
- Which animals/plants that we listed can be found in our community? On other continents? (You may want to set up a table with the continent names and list the animals under their home areas.)

Activity 2. Exploring Field Guides

OBJECTIVES

Students will be able to
1) explain the concept of biodiversity/biological diversity; and
2) group living things by observable attributes.

MATERIALS

Library books describing nature, especially field guides of birds, mammals, insects, insect pests, reptiles, amphibians, trees, wildflowers, and weeds.

Blackline Masters:
SPICESHEET II
SPICESHEET III
SPICESHEET IV

PROCEDURE

1. Describe the collection of field guides and nature books you have brought to the classroom on animals and plants.

2. Divide the class into small teams and give each a book. Have students examine the books. As they examine their books ask these kinds of questions:

- What are the common characteristics of the organisms found in your book?
- The organisms in the books are grouped together based on similarities. What are some differences you notice about these organisms?
- Find an example of something you have seen. How can you use the book to find information about where it lives?
- What thoughts and feelings do you have about the organisms shown in your book?

3. Give each team a copy of the blackline master, SPICESHEET II. Emphasize that students are to identify key properties, e.g., for a group working with trees a category might be conifers (needle-like leaves, cone-bearing) or more specifically, pines (evergreen, 2-5 needles per branch, cones). For some categories there may be more space than students need.

If there are coniferous trees on the school property bring in some needles. Are the needles in bundles? Spruces have single, four-sided needles. Firs have flat needles. Can students feel the sides? Roll them between their fingers? Are the needles sharp? Dull? Stiff? Soft?

This is a good time to start a nature collection table. Some students may be collectors already. Encourage students to bring in what they find. Students should bring only dead animals—insects, butterflies, beetles, seashells, pressed leaves and flowers, twigs and small branches, pine cones, fossils, snake-skins, bits of fur, feathers. Leaves and flowers can be laminated. Students SHOULD NOT pick wild flowers for this table. This is a good time to discuss why we shouldn't pick wildflowers—their purposes, their right to exist, and the laws.

Over the years, this interest table can become a permanent collection. Students can develop museum cards for the items that provide interesting information to a visitor.

4. Give each team a copy of the blackline master, SPICESHEET III. Review the sheet with them. An example of a similarity may be the eye of an organism and its color. On the other hand the eyes may be different. They may be different colors or have a ring around them.

When students are finished ask them to describe some of the similarities and differences they noticed. Be sure students describe not only WHAT is different but HOW it's different. You are trying to help them expand their observational and descriptive skills.

5. Distribute copies of the blackline master, SPICESHEET IV. Have several teams describe their findings.

Activity 3. Make a Thumbprint Bulletin Board of Biological Diversity: Genetic Level

OBJECTIVES

Students will be able to
1) identify variation in human physical characteristics and preferences; and
2) measure and analyze variation.

MATERIALS

For the Class
Stamp pads
Water, soap and paper towels

For Each Team
Unlined index cards, 3" x 5" (or plain paper)
Scissors
Magnifiers

PROCEDURE

1. Have students work in pairs. Give each team a card. Make a drawing on the chalkboard to show students how to divide and label the card.

Name _____	Name _____
Right Thumb	Right Thumb
Left Thumb	Left Thumb

2. Have students wash and dry their hands. Then press their thumb flat on the stamp pad and flat on the card. Do this for the right and left hand. Practice a few times on a separate sheet of paper.

3. Have students examine their thumbprints.
Are your right and left thumbprint exactly alike?
Compare your thumbprints with those of your partner.

Are they alike? Exactly alike? Describe any differences.
Cut the cards in half and compare your thumbprints with another person. Are they alike? Exactly alike? Describe any differences.

4. Post the prints in a place where students can view and study them for the next few days. (Label the poster, e.g., WANTED: TWO THUMBPRINTS EXACTLY ALIKE or THUMBPRINTS: NO TWO ALIKE.)

5. If you wish, students can take the stamp pad home and record thumbprints from members of their family. (Perhaps a dog, cat or pet bird would be willing to provide some new evidence, too. Do they have unique "fingerprints?" If not, how can individuals be identified? Nose prints are used to identify individual dogs. Biologists studying lions have learned to identify individuals by their whisker patterns.)

6. Introduce the term VARIATION. Tell students that VARIATION refers to the differences among individuals. Each living organism shows variations. Sometimes it's in the way we look or behave. Ask students, how do fingerprints show that every person is different? How is this information used? Have you ever been fingerprinted? (Have students check their birth certificates.)

Activity 4. Examine Similarities and Differences in the Classroom

OBJECTIVES

Students will be able to
1) identify variation in human physical characteristics and preferences; and
2) measure and analyze variation.

MATERIALS

For Each Team
Ruler (metric preferred)
Meter stick/yard stick/centimeter or inch tape measure
String
Paper/construction paper

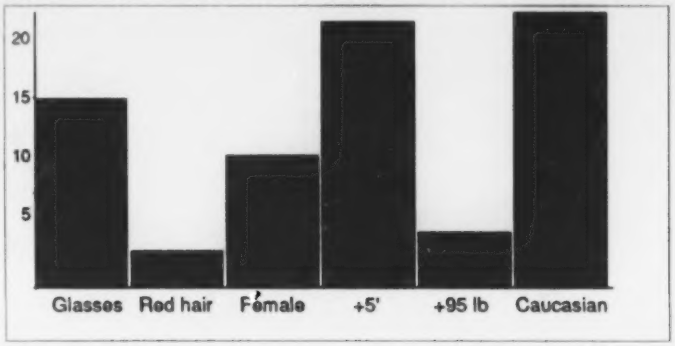
Blackline Master:
SPICESHEET V

PROCEDURE

1. Divide the class into pairs. Distribute copies of the blackline master, SPICESHEET V. Have students record measurements. Put the following instructions on the chalkboard.
•Shoe size. Record as the next highest whole number. If your shoe size is 5 1/2, record 6; if it is 6 1/2, record 7.
•Shoe length. Round off to the nearest centimeter (or inch).
•Hand length. Measure the LEFT hand from the base to the tip of the finger. (Sometimes there is a convenient wrinkle at the base of the hand.)
•Index finger. Measure the LEFT index finger, from the top of the knuckle to the tip of the finger (not the end of the fingernail.)
•Height. If you don't have meter/yard sticks use string. Show them how to use string to measure the height of someone. Put a pencil or pen mark at the top.
• You Decide. This is something for the students to decide to measure. Ankle, wrist, nose length, arm length, hand width etc. If students want to measure "distance around" they can use string. Wrap the string around the body part, e.g., ankle, and mark the distance with a pencil or marker. Then measure with a ruler.

2. Have students graph their data. First, provide them a couple of examples on the chalkboard, e.g., number of girls and boys, eye glasses (contact lenses count!), hair color. Make a bar graph on the chalkboard with numbers of students on the vertical axis and the attribute on the horizontal axis.

3. Now divide the class into 7 small groups and have each group graph one piece of the data collected. You will probably want to be able to compare the graphs so decide on a standard scale. This is especially important on the vertical axis. The vertical axis number might be 2 centimeters (or roughly 3/4 inch) apart; the horizontal bars could be 2.5 cm wide (or roughly one inch).



4. Display the graphs around the room and discuss them.
- Which bar has the most _____?
- How many other people liked your wild animal best?
- Which bar has the least _____?
- How many more _____ are there than _____?
- Which graph has the most number of attributes? The least?
- Are there any graphs with bars the same?
- How could we find out if tallest students have the biggest feet?
- What are some other things we might investigate to learn more about variability in our class?

5. Have students write a description of the class that would help a visitor (a guest speaker) or someone you are going on a field trip with to know more about your class. Ask a few volunteers to read their descriptions.

6. There are some other human characteristics that kids will enjoy learning about. Some people can roll up the sides of their tongues into a U shape; others can't and we refer to them as rollers and non-rollers. Some of us have free ear lobes and others of us have attached ear lobes. There are people with chin dimples and people without them. Some of us have a hairline that is referred to as a widow's peak; others don't. Collect the data and have some volunteers make graphs to display the data.

SECTION II. NATIONAL PARK—ON-SITE ACTIVITIES

Activity 5. Exploring the Tools of the Trade

OBJECTIVES

Students will be able to
1) describe the use of scientific equipment to study plant and animal biodiversity in the field;
2) become aware of what scientists learn when they study biodiversity.

MATERIALS

Compass
Flagging
Meter stick or measuring tape
Telemetry equipment
(collars, antennas, receiving equipment)
Nail polish
pH paper (indicator paper)
Markers
(bird bands, ear tags)
Paper tags
Netting
(aquatic, plankton, avian)
Sample bags
Plaster casting
Field data sheets
Field notebooks
Calipers
Live/Snap trays
Soil auger
Increment corer
Plant press
Field guides
Tree harness
Vasculum
Magnifiers

PROCEDURE

1. Choose a place. It could be a section of any park trail. It may include one plant community or two or three of them. Place some tools used by scientists to study biodiversity along the trail or in the community. Try to make them blend into their surroundings. You may want to put some of the tools in plastic bags to protect them.

Some of the tools can be placed in the environment in a way a scientists would use them. For example quadrants, browse studies, plant tags, small live traps can be placed in strategic locations the night before. Demonstrate the use of the tools and give students an opportunity to use them. You can use them to tell interesting stories about biodiversity, much of it based on research in or near your park setting. Students will gain some insights into how biodiversity is studied while also learning about biodiversity.

The list of biological diversity tools does not include all the possibilities. Your park/regional scientist can describe research and equipment unique to your situation, suggest and help you relate the scientific equipment to the study of park biodiversity. While there is no question that scientific instrumentation has become increasingly sophisticated, there is much research that is done in the field with quite ordinary materials. One item of this kind in the list is nail polish, used, e.g., to mark snails/insects.

Activity 6. Biological Diversity Hunt

OBJECTIVES

Students will be able to
1) identify some of the biodiversity of a particular area (habitat/community/ecosystem; and
2) describe some differences between separate areas (habitats/communities/ecosystems).

MATERIALS

Blackline Master:
HUNTING FOR BIODIVERSITY
Optional: Flagging

PROCEDURE

1. Make a copy of HUNTING FOR BIODIVERSITY and cut it into cards. Place them in a sturdy envelope. Add your own site specific cards.

2. Use a trail that goes through a variety of habitats/communities/ecosystems. Select two or three sites that are different and are easily supervised. Point out the boundaries of the area. You may want to use flagging to mark boundaries. Remind students that they are not to collect or damage anything.

3. Divide the class into teams of three curious naturalists. Give each team two cards.

4. Give each team ten minutes to find what their cards ask for. Have the teams take the class to the finds. Collect the cards or have students exchange them for use on the next site.

5. Ask students these kinds of questions:
•What are some words that describe the plants growing on this site? (This is a good time to remind students that all the plants and animals living together here make up a community. If it has a name, name it.)
•What did you learn about animals on this site?
•What are some ways we could learn more about the animals on this site?
•How would you describe the biological diversity of this site? Rich or Poor? What is your evidence?
•Did anyone find a plant or evidence of an animal that no one else found?
•Are some plants more abundant than other plants?
•What would you say is the least abundant plant on the site?
•How is this habitat/community/ecosystem similar to the one we just studied? How is it different?
•What are some words you would use to describe this place?
•If appropriate, which team found evidence of species diversity? Individual variation?
•Which of us is best dressed for hiding in this area? Break the class into small groups. Give them a minute to invent a game to test that.

SECTION III. CLASSROOM—POST-VISIT ACTIVITIES

Activity 7. Biological Diversity in an "Un-natural" Area

OBJECTIVES

Students will be able to
1) collect quantitative evidence of differences and similarities; and
2) make statements supported by evidence about their findings.

MATERIALS

None required

PROCEDURE

1. Have students bring leaves of the most common plants from their lawn (e.g., up to six). If you live where students can bring them from vacant lots or old fields or wooded areas, use them. Just be sure students are collecting from the same type of area. Collection of specimens should never be indiscriminate. Encourage students to collect only what is necessary.

2. Have students make a real graph of their data. One student places a leaf down on the floor (or table) and starts a column. Students with similar leaves should place their leaves in that column. When all the leaves of one kind have been placed, invite a student to start a new column. When students have completed placing leaves in columns, encourage them to examine all the leaves. Do the leaves in each column belong there? If there are disagreements, ask students to compare shape, color, texture, odor.

3. When they are finished, ask these kinds of questions:
- How many columns are there? Are any of them equal?
- Which column has the most leaves? The least leaves?
- Ask a student naturalist to describe the leaves in one of the columns. S/he should not identify the column. When another student naturalist thinks that s/he knows which it is, s/he should raise her or his hand and identify the column.
- Have a student naturalist leave the room. The rest of the class chooses a mystery column. After the student naturalist returns to the room, s/he tries to identify the column using questions that can be answered yes or no.
- We collected samples from _____(name the area). Did we find more or less biological diversity? Or was it about the same? How do you know?
- If we collected samples from _____(name a familiar location), do you think we would find more or less biological diversity or would it be about the same?

Activity 8. Take a Guided Fantasy Experience Trip

OBJECTIVES

Students will be able to
1) describe changes in plant and animal communities;
2) describe the accumulation of biodiversity over time; and
3) use appropriate words/media to describe experiences.

BACKGROUND

This activity is based on the work of Henry C. Cowles, a professor at the University of Chicago, who in 1899, published an article describing changes in biological diversity on the southern shores of Lake Michigan. Cowles was curious about how beech-maple forests had become established on old sand dunes. Once the site of these forests had been dry, sandy beaches. Based on field observations, Cowles inferred that the beech-maple forest was the product of a long sequence of events. While the beech-maple forests of these sites are like those growing on rich most soils elsewhere, the soils under these trees are only a few centimeters thick and are underlain by loose sand.

Develop a guided imagery experience describing the accumulation of biodiversity for your own area.

MATERIALS

For Each Group
Newsprint/Butcher paper
Colored markers
Paints/crayons

PROCEDURE

1. Choose a location where human intrusion, especially sound, is minimal. Have the students find comfortable places to sit or lie down. Once students have settled down and everyone is quiet, begin reading the script.

TIMETRIP: BARE GROUND TO BIOLOGICAL DIVERSITY

Close your eyes and relax. Please concentrate on what I'm saying. Try to imagine what I describe with your "mind's eye." You are a member of an expedition from another planet studying Planet Earth. Two of your team members have just returned from Earth to your space station. They have discovered an old satellite which they brought back with them. When the satellite was opened a remarkable film was found.

So far, no one knows who took it. The film is a history of plants and small animals of a beach taken from a long time ago up to present. The film is short—about the length of a television program and was shot in a special way. Every few years it took pictures of the same lakeshore in Michigan.

You have been invited to the viewing room to see it. You are excited about seeing a film that no one else has ever seen before. The lights dim and a printed instruction fills the screen. It says, "For the next 100s of years this place will be filmed from time to time. Map readings are Alpha 23905; Beta 91." You wonder what those map readings mean and think that it's a strange way to identify a place.

Then you see a picture. It's blue. Very blue. There is something about it that makes you think it is a very large lake. You know it is when your eye catches the storm line of the beach, the place where water is highest during fierce storms. As the camera lens moves over the wide beach, inland, away from the lake, you are surprised to see sand dunes. The beach is very wide. It looks like a desert. The wind is blowing sand about and you can see the dunes changing their shape. You imagine the sound of the wind and the swirling sound of the sand. The dunes seem almost alive...they are always changing shape. The camera lens zooms in and you can see finer details. Inland, away from the shore, you can see grasses growing. You notice that the wind is not blowing much sand around at all. It all looks very dry, very hot and appears very still. Quiet...just the wind, sand and dune grass. In other places along the beach where there is less sand dune grass, the wind blows sand up and over the plants.

Where the wind has blown especially hard you can finally see how these plants spread and grow. They creep their way underground. Parts of the plants that grow underground send up shoots or plant stems as they move through the sand. In some of the larger areas completely covered by sand dune grass there are small shrubs and trees—willow, cherry and cottonwood. You can even see some small animals, too. The expedition scientists point out burrowing spiders, grasshoppers, and digger wasps. You see the grasshoppers jumping. You can hear them "sing" as they rub one body part against another. In the next part of the film the trees have grown older. The cottonwood is now a very big tree, providing lots of shade. It is Fall and the thick yellow leaves are drifting lazily to the ground below. The small sand animals are mixing the leaves with the sand grains, forming the first soil.

In other places there are small pine trees with their needle-like leaves growing under the cottonwood, willow and cherry forest. In the next part of the film the pine forest has grown up and the cottonwood trees are gone. You can see some new critters—ants. The "bug" expert in the audience points out some animals called sand locusts and new kinds of digger wasps. The ground is covered with pine needles and here and there you see some young oak plants. The film rolls forward and you are surprised to see that the pines are gone and that the oaks have grown into an oak forest. There are lots of thorny shrubs, too...blackberries, gooseberries and prickly ash.

On the ground there are new kinds of grasshoppers and you keep track of their number as the lens probes the forest floor! "One...two... three...four...five...six new kinds of grasshoppers." Here and there you see snails for the first time. All of a sudden one of

your team yells out, "antlion"—another new critter. To you they look like neither ant nor lion. The "bug" expert tells you that they eat ants that fall into pits they make. So to an unwary ant they first might appear to be lions.

The woods has become a very different place than the original dry, sandy beach you saw at the beginning of the film. In some of the shadier places you see new kinds of seedlings. Someone announces that these are young maple and beech trees.

Then, all of a sudden, a rich, fully-grown beech-maple forest appears on the new screen. The oaks are gone. In a place where an animal has dug into the ground you see that the soil has really changed. it is no longer pure, dry sand but is now a deep and lovely coffee brown. You imagine the delicious odor of this soil after a soft summer rain. It smells so rich...like it could grow anything.

In the soil and leaves there are millipedes (1,000 legged "worms"), centipedes (100 legged "worms"), sowbugs, all kinds of new snails, crickets, and even earthworms. You know that the soil is rich. The ground is covered with plants. There are about a dozen other kinds of trees and 100 or so smaller, different kinds of plants—shrubs, creepers and plants whose flowers and scent make it so pleasant during a short couple of weeks in the Spring. You want so much to visit this place in the spring and to smell those flowers.

The view screen turns dark and the room lights remain off. It is very quiet. You wonder about all the changes. A quite barren place with just a few kinds of plants and animals has changed over a long period of time to a place with many different kinds of plants and animals. Everyone is trying to understand and remember what they have seen. At first there was just a bare beach followed by grasses...cottonwoods...pine...oaks...and then a rich forest of maple and beech, trees with all kinds of other plants. You think to yourself that it's kind of like not mowing your lawn all summer or letting a vacant lot grow up.

When you feel ready, open your eyes and stretch if you'd like. It's time now for us to return to class. Let's do it slowly and quietly. There is no need to hurry.

2. Five options for debriefing.'

a. Divide your class into groups of four to six students. Give each group a sheet of newsprint. Ask one student to serve as recorder. The recording should be done in columns. Students in each group are to call out what comes to their minds when they think about the picture they just "saw." Students are not to edit or make editorial comments about the words they list. Encourage long lists, 30 to 60 or even more.

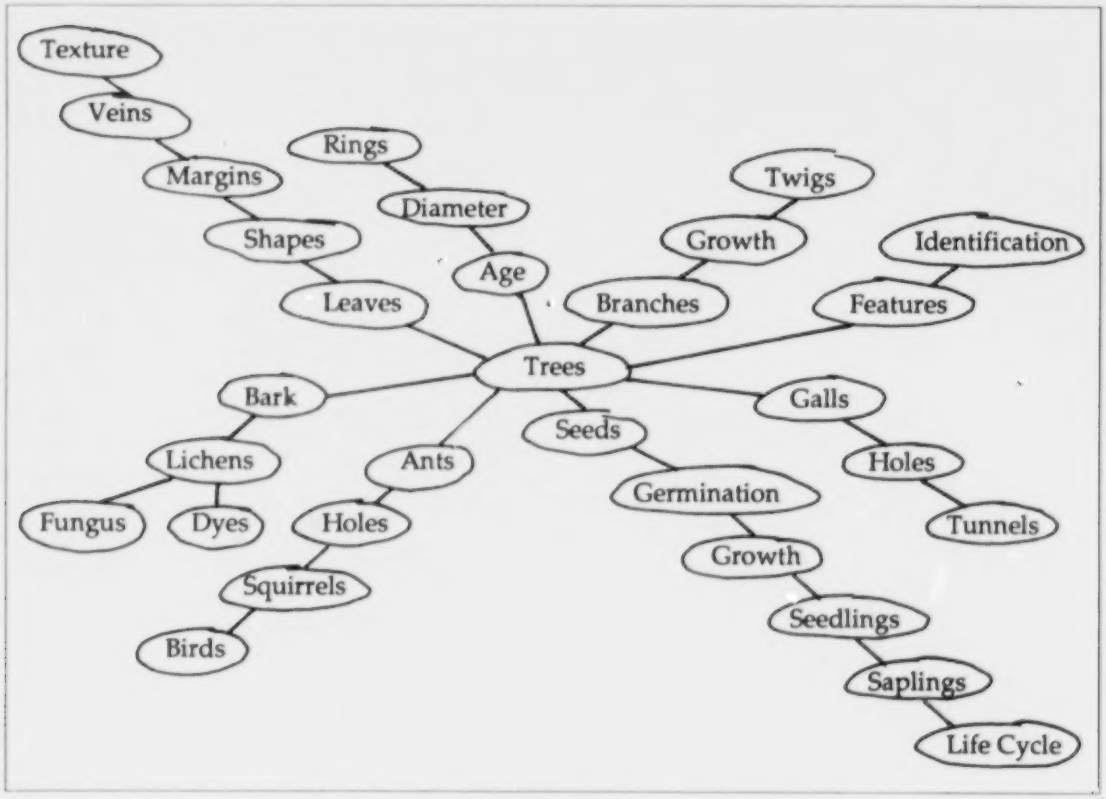
Now, have students use some of the words to write a statement about biodiversity. Post the sheets and have the class examine the diversity of responses.

b. Have students draw or paint a picture of their favorite image or of the entire "film" or what this place looked like when it was young/middle-aged/old.

c. Ask students to relax again and to close their eyes if they would like. Ask them to "see" the movie again. Encourage them to think about color, textures, relationships and other details that occur to them. Then, have students write whatever comes to mind...phrases...strings of words... sentences. Be sure writing materials are handy. Now, have students read and examine what they have written and to edit or rewrite it. If they want they can use a new sheet of paper. Collect the papers and read them aloud.

d. Divide your class into small groups of six students. Give each group a sheet of newsprint. In big bold print in the center of the paper place IN THE COMMUNITY, WHAT IS CHANGING? Students are to use this as a starting point to make a word map. The idea is to chain or link related events, ideas, and processes together. Have students draw circles/ovals around connected thoughts and feelings and to physically connect them with a line. An example of a concept map is shown below.

e. Make a poster that celebrates biological diversity (biodiversity) or a poster that shows how biological diversity (biodiversity) changes as a plant community gets older.



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Activity 9. Scavenge for Biological Diversity

OBJECTIVES

Students will be able to
1) investigate biodiversity at many levels;
2) make comparisons;
3) make observations about numerical and spatial aspects of biodiversity; and
4) become sharper observers of their outdoor surroundings.

MATERIALS

Rings or yarn
Punch

Blackline Master:
BIOLOGICAL DIVERSITY CARDS

PROCEDURE

1. Copy the BIOLOGICAL DIVERSITY CARDS (onto heavy paper if possible) and cut them up into cards. Punch a hole in the upper left hand corner of each card and place them on a ring or thread yarn through them. Group them into categories or into small bunches if you want.

2. Use the cards to investigate the biodiversity of your school yard or immediate neighborhood. How many can your class complete in a day or a week or a month?

3. If you take students camping, use the cards.

4. There are a variety of ways these experiences can be summarized. Students can write descriptions, write poems/haiku, contribute their observations to a class book or chart on biological diversity, make an illustrated report or make a large group/class mural. You might ask the class to develop a list of words that describes the different plants and animals they found and studied. Then use the same cards in a different place—another community. Develop another descriptive list of words and then ask students: What does this community we just studied have in common with the community we studied two days ago? In what ways do the two communities differ?

EVALUATION

1. Place students in groups of four or five. Give each group five to ten minutes to develop a way to express biodiversity. It may be a dance or a play or a reading.

2. What are some reasons that there is less biodiversity in human communities than in natural communities?

3. How is human diversity similar to biodiversity? How is it different?

4. What is the chief characteristic of a place that has more biodiversity than another place?

5. What things does your community have in common with the park community? In what ways do the two communities differ?

6. What question has been raised by our study of biological diversity?

7. You may have heard someone say, "Variety is the spice of life." What does this have to do with the biodiversity of plants and wildlife?

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SPICESHEET I

Team Members _____ Date _____

A. PREDICTIONS

In the following spaces write the number you exp to find:

1. Number of different kinds of organisms _____

2. Total number of organisms _____

B. REPORT

1. On a separate sheet of paper make one drawing of each kind of organism found. On each drawing write the total number of that kind of organism found.

2. When you are finished finding and describing your organisms:
- Total number of different kinds of organisms you found _____
- Total number of organisms _____

C. COMPARE

Pick two different organisms.

List 5 ways they are the same.	List 5 ways they are different.
_____	_____
_____	_____
_____	_____
_____	_____
_____	_____

SPICESHEET II

Team Members _____ Date _____

1. The information in field guides is organized into major groups. How many are there in this book? List them.

_____ _____

_____ _____

_____ _____

_____ _____

2. Scientists describe objects or organisms by listing their properties. For 4 different groups of organisms, pick an organism and list the properties. Write the name of the groups you choose.

GROUP: _____ GROUP: _____

_____ _____

_____ _____

_____ _____

_____ _____

GROUP: _____ GROUP: _____

_____ _____

_____ _____

_____ _____

_____ _____

SPICESHEET III

Team Members _____ Date _____

Pick two colored (if possible) drawings of organisms that are on the same page. Look at them very carefully.

Write down as many things as you can that are similar and different about them.

Organisms Chosen: _____

A. SIMILARITIES
For each similarity describe what is alike and how it is alike.

1. _____

2. _____

3. _____

4. _____

5. _____

B. DIFFERENCES
For each difference describe what is different and how it is different.

1. _____

2. _____

3. _____

4. _____

5. _____

SPICESHEET IV

Team Members _____ Date _____

Pick a page of drawings in a nature book or field guide and look at them very carefully.

A. Name of book and author:

_____

B. The objects shown on this page are grouped together because they are similar. What two show the greatest difference (diversity)? Explain your answer.

_____

_____

_____

_____

_____

C. The objects in this book are grouped together based on their similarities. Find the two most dissimilar organisms. Note the name and page number of each of the organisms you chose. Complete the following chart.

Organism 1 _____ p. ___ Organism 2 _____ p. ___

How Are They Alike/Different?

Alike	Different
_____	_____
_____	_____
_____	_____
_____	_____
_____	_____

SPICESHEET V

Name	Name
Shoe Size	Shoe Size
Eye Color	Eye Color
Shoe Length	Shoe Length
Foot Length	Foot Length
Height	
Left Hand Length (Base of hand to tip of longest finger)	Left Hand Length (Base of hand to tip of longest finger)
Left Index Finger Length (Top of knuckle to tip of finger)	Left Index Finger Length (Top of knuckle to tip of finger)
Favorite Wild Animal	Favorite Wild Animal
You Decide	You Decide
You Decide	You Decide
You Decide	You Decide
You Decide	You Decide

HUNTING FOR BIODIVERSITY

FIND THREE DIFFERENT SIZED LEAVES FROM THE SAME PLANT	FIND AT LEAST THREE DIFFERENT KINDS OF HOLES MADE BY ANIMALS
FIND AT LEAST THREE DIFFERENT OF KINDS OF PLANTS GROWING UNDER A TREE	FIND THREE DIFFERENT SIGNS OF AN ANIMAL HAVING EATEN SOMETHING
FIND AT LEAST THREE DIFFERENT ORGANISMS AND GIVE THEM DESCRIPTIVE NAMES	FIND AT LEAST THREE DIFFERENT KINDS OF LEAVES
FIND AT LEAST THREE DIFFERENT KINDS OF PLANT "SKINS"	FIND AT LEAST THREE LEAVES WITH DIFFERENT TEXTURES
FIND A PLANT WHICH HAS THREE DIFFERENT COLORS	FIND AT LEAST THREE DIFFERENT PLANTS
FIND AT LEAST THREE DIFFERENT KINDS OF SEEDS	FIND THREE DIFFERENT KINDS OF CONSUMERS (ANIMALS) OR EVIDENCE OF THEM
FIND THREE DIFFERENT SPIDER WEBS	FIND THREE DIFFERENT KINDS OF DECOMPOSERS
FIND AT LEAST THREE DIFFERENT KINDS OF LEAF STALKS	FIND AT LEAST THREE PLANTS WITH DIFFERENT ODORS
FIND THREE DIFFERENT LICHENS	FIND BIODIVERSITY IN AT LEAST THREE DIFFERENT SHAPES— SQUARE, TRIANGLE, OVAL, HEART, RECTANGLE
FIND THREE DIFFERENT FLOWERS	FIND AT LEAST THREE DIFFERENT INSECTS

BIOLOGICAL DIVERSITY CARDS

Find something in nature ready to burst.	Find a biodiverse place.	Find the opposite of a biodiverse place.
Find a smooth bud. A sticky one.	Find a rock with things living on it.	Find an animal with six legs.
Turn over a rock. How many different living things can you find?	Find ten fruits, (They must be the same kind), each one different in some way.	Find as many animal homes as you can.
Find an animal with no legs.	Find an animal with more than six legs.	Find a plant or animal in the shape of a triangle. circle. oval. square.
Find a plant that is smooth. rough. prickly.	Place an obstacle in the way of an animal. What does it do?	Listen to the woods. What sounds do you hear?
Find an evergreen your age. How are you alike? How are you different?	Name three benefits of biodiversity 1. 2. 3.	Make a mask of your favorite wild plant or animal that you have seen outdoors.

BIOLOGICAL DIVERSITY CARDS

Find a plant and describe its habitat.	Find a change made by humans that decreased biodiversity.	Find a change made by humans that increased biodiversity.
Make a temperature map of a biologically diverse area.	Make a temperature map of an area that is not biologically diverse.	Find a change made by human that has changed biodiversity.
Make a moisture map of a biologically diverse area.	Make a moisture map of an area that is not biologically diverse.	Observe and record a change in an organism.
Make a sunshine/shade map of a biodiverse area.	Make a sunshine/shade map of an area that is not biologically diverse.	Find out how an organism changes its environment.
Find out how an organism reacts to another organism.	Find a plant predator.	Find an animal predator.
Find a place where there is a plant in front of, to the left of, to the right of, and behind you.	Put your pencil point on a sheet of paper. Trace the fall of three different leaves.	Find a human-like face in nature.

BIOLOGICAL DIVERSITY CARDS

Find a common plant.	Find a rare plant.	Find an ecosystem map. In which ecosystem do you live?
How many of these live in your area— ☐ animals ☐ shrubs ☐ trees ☐ spiders ☐ insects ☐ ferns ☐ mushrooms	Find as many different leaves as you can.	Describe the bark on two different species of tree. How are they different?
Draw pictures of the life cycle of a tree.	What are some key characteristics of trees birds insects spiders mushrooms	Count the fingers on different oaks to see what differences there are among kinds.
Collect wild seeds. Describe them. Labels their parts.	Find ways a dead tree is being used when it is still standing. When it has fallen down.	How many ways can leaves be grouped.
Find biological diversity in a jar of pond water.	Find an animal or plant that is a symbol of a nation. A state. A team. A car.	Ask four people what biological diversity means.
Select a wild animal. What changes do you notice in summer. In fall. In winter. In spring.	Select a wild plant. What changes do you notice in summer. In fall. In winter. In spring.	What wild plants in your area are used for food.

BIOLOGICAL DIVERSITY CARDS

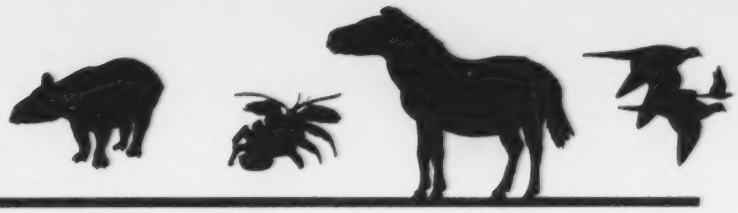
Find the five most common plants in two different communities. How are they alike? How are they different?	Find the three most common plants on the ground in the woods. In a field. In a wet place. In your schoolyard.	Find six plants with protective parts (a sting or thorns). Be careful!
Find three different kinds of buds (with different things like color, shape, size, scales, shininess, wooliness).	Find animals living in leaf litter.	Find animals living in the soil.
Find animals living on shrubs. Place paper or plastic on the ground and brush or shake the shrub with a stick.	Find three different animals. What words describe their shape?	Find three different ways that plants climb.
Be an animal detective. Find evidence that animals have been in a particular spot.	What words describe the texture of: two different trees, an earthworm, two different shrubs, a snail, a grass blade.	Find the largest and the smallest leaves from a lawn. A tree. A shrub.
Find two different trees about your height. How do the branches grow from the trunk?	Look under a tree. Find all the different parts you can that have been shed by the tree.	Find three different shrubs with different colored stems.
Find plants of the same kind growing in a shady spot and a sunny spot? How are they alike? How are they different?	In an old field community, find all the dead plant parts you can.	In the fall, find a spider web. Examine the remains of their captives.

BIOLOGICAL DIVERSITY CARDS

Find a lichen. Look at it with a magnifier. Describe what you see.	From where you are standing, how many different plants can you see?	From where you are standing, how many different aniamls can you see?
Find a producer.	Find a place in your community where biodiversity is threatened.	Find something living in a wild place that is also living in your community.
Find a consumer.	Find two flowers that look the same but smell different.	Find a decomposer.
Find a population.	Name some populations in your community.	Describe two differences between a young organism and an old organism.
Find a food chain.	Find evidence of the presence of earthworms. Of ants.	Find evidence of the presence of a large animal.
Find evidence of a plant's response to an environmental factor.	Find evidence of a plant's response to a non-living factor.	Find evidence of a plant's response to a living factor.

BIOLOGICAL DIVERSITY CARDS

Find a seed that travels by wind.	Find a leaf that feels hairy.	Find a smooth leaf.
Find a leaf with parallel veins.	Find a plant whose leaves grow right next to the ground.	Find a seed that travels by sticking to things.
Find an animal home.	Find a leaf with holes in it.	Find a leaf with bumps.
Watch a plant for at least ten minutes. Record the amount of time and kinds of insects that visit it.	Find a leaf with veins that start from a central point.	Find a shrub or tree with teeth marks on the stem.
Find a leaf whose veins start from a central vein.	Find at least three different ways evergreen tree needles attach to branches.	Find a leaf whose edge (margin) is smooth. Wavy. Saw-tooth. Lobed.



Unit 2

EXTINCTION IS FOREVER

OVERVIEW

Through guided imagery, questionnaires, research projects and games in the classroom and in the field, students learn about the process of extinction and the role of human beings in the process.

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TEACHER BACKGROUND

Extinction, if you will, is a way of life for all organisms on our planet. Species appear then in time, die out. However, once an organism disappears—becomes extinct—it never reappears again.

The rate of extinction has changed. Never before, in all of the earth's long and varied history, has there been the massive disappearance of plants and animals that is occurring today. Within the next 30 years, perhaps as many as one million different plant and animal species will vanish forever. This is a loss of 2 to 3 species an hour. According to Paul Opler, "since the arrival of the Puritans at Plymouth Rock, over 500" types of animals and plants have become extinct. Contrast this with 3 species per hundred years during one 3,000-year period of Ice Age extinction. During the demise of the dinosaurs, the rate of loss was only one species every 10,000 years.

Why are we losing so fast? Direct or indirect human interference in the form of habitat loss, commercial exploitation, extermination of feared species, and pollution. While pollution and over-harvesting have had some effect, the main reason for this greatly accelerated and unnatural pace of extinction is habitat loss. This is especially true in the tropics where at least half of all life forms on earth may reside.

SECTION I. CLASSROOM—PRE-VISIT ACTIVITIES

Activity 1. And Then There Were None

OBJECTIVES

Students will be able to
1) describe the impact of humans on other living things as a result of human social, economic, and political activities; and
2) to define the terms endangered and extinct.

MATERIALS

For the Class
Blackline Masters:
I AM....
SURVIVAL FACTORS

For Each Student
Tape
6 small slips of paper

PROCEDURE

1. Copy and cut the I AM and SURVIVAL FACTORS into cards. Have the children arrange their chairs in a circle. Tape the name of an animal or plant to their blouses/shirts. The plants and wildlife found on the blackline master I AM are mostly endangered species. They are all native to the United States. (If you prefer have students choose plants and animals growing in their area.)

2. Distribute six slips of paper to each student. Tell them that this represents a population of organisms. If necessary, review the population concept. Write the word POPULATION on the chalkboard. Remind them that a population is two or more organisms of the same kind; there are plant and animal populations; and that the size of a population is determined by the number of individuals. The student populations are all the same size. Point out that organism size makes no difference in the size of populations. Population is about numbers of organisms. Tell them that each of their slips represents millions of organisms.)

3. Tell students that you are going to read some statements. Give them the following directions:

> "Everyone stand up in a circle. Each time I read a statement that limits or reduces your chances of survival put one of your slips on the floor in front of you. Whenever I say, "Human Population Growth," everyone turns in a slip. When you have two slips left, sit down on the floor and say, 'I'm in big trouble.'"

Continue to play until everyone is sitting.

4. Discuss the game asking questions such as:
•How many of you have slips left? How many have none?
•Is this game life-like? Why or why not?
•What are the important ideas in this game?

5. Write the words EXTINCT and ENDANGERED on the chalkboard. Tell students that their populations became endangered when they became small in number. Endangered refers to any population of plants or animals in danger of extinction. There are still some left. Extinction is final. The plant or animals is "gone forever."

Ask students whether they have even seen a building being torn down or whether they have ever lost something they have never found. If so, they have some idea and feeling about extinction.

Tell students there is an official list of Endangered Species. Plants and animals are placed on this list after careful study and review by the Office of Endangered Species, U.S. Fish and Wildlife Service.

6. Summarize this lesson with a discussion. Use these kinds of questions:
•What are factors that influence the survival of populations of plants and animals? Can you think of some factors that this game did not consider?
•Does this game contain any facts? What are they? Are they accurate? How could you find out?
•Did populations have any choices? Why or why not?
•How could this game be changed to make it even more like real life?
•How would you change this game to have winners? (Does this game have any winners?)
•Do populations lose this game by chance? Is this life-like?

Activity 2. A Passing in Cincinnati, September 1, 1914

OBJECTIVES

Students will be able to
1) describe their impressions of the extinction of a species;
2) identify the factors involved in the extinction of a species; and
3) have some feeling of "gone forever," that once a species has disappeared it does not reappear.

MATERIALS

For the Class
Blackline Master: MARTHA

For the Students
Art materials
Writing materials

PROCEDURE

1. If you have a wooded area near the classroom where it is reasonably quiet and where there are nuts and berries, use it. You can give each student an acorn/berry—the food of the passenger pigeon—to hold during the story (Blackline master: MARTHA).

2. Students can sit or lie down. Begin the story of MARTHA. Ask students to relax quietly and sit or lie quietly and close their eyes. Ask them to imagine the sights and sounds of the story.

3. When you have completed the story, ask them to write their thoughts and feelings about Martha. They can use poetry or sentences. Be sure to give them enough time. Then ask them to draw or paint a picture to illustrate the story.

4. Discuss the pictures. Use these kinds of questions:
- How do you feel about losing this animal?
- Are you familiar with any other incidents of this kind?
- Is the extinction of the passenger pigeon a disgrace? No one says this about the extinction of the dinosaurs. Is anything different?
- What factors contributed to the extinction of the passenger pigeon? (hunting, habitat destruction)
- (In 1857, a bill was introduced in Ohio to protect the passenger pigeon. A committee of the state legislature reported, "The passenger pigeon needs no protection. ... no ordinary destruction can lessen them.") Why do you think the committee made that decision?
- What lesson can we learn from the extinction of Martha?
- Do you think we have learned the lesson? What is your evidence?

•Can organisms become extinct today? How do you know?
•Have any organisms ever become extinct in the area where we live? How do you know? How could you find out?
•What do you think other people know about extinction? How could you find out?

Activity 3. Develop a Questionnaire

OBJECTIVES

Students will be able to
1) gather and organize information;
2) make inferences from organized information; and
3) examine evidence critically.

MATERIALS

Blackline Master:
A QUESTIONNAIRE ON EXTINCTION AND ENDANGERED PLANTS AND WILDLIFE

PROCEDURE

1. Polls and surveys are important tools used to assess attitudes and knowledge about a diverse range of issues in a systematic way. The very best way for students to learn about questionnaires is to have them prepare, administer and analyze a survey of their own. Students should decide:

- the purpose of the questionnaire
- the type of information that will fulfill the purpose
- question types
- the sample (#, who—male, female; adult, students)

In the event that you do not want to develop your own survey, the Blackline Master: A QUESTIONNAIRE ON EXTINCTION AND ENDANGERED WILDLIFE is included for your use in investigating some questions about extinction and endangered species.

2. Make copies of the questionnaire and discuss it with the students. You should discuss sample size (number, who—students/adults) and give students an opportunity to practice introducing themselves and administering the questionnaires.

3. When the data are collected, have the students summarize and analyze them.
- Do more people say "yes" than "no?"
- How sure did people seem to be about their answers? How can you tell?
- Are you surprised by any of the answers? In what way?
- How does our class compare?
- Did you have any problems conducting the questionnaire? What kinds?
- Suppose you were to do this survey again. Would you change the questions? Which ones? How? Why would you change them?
- How many different organisms were mentioned altogether?
- Are some organisms mentioned more than others? Which ones?
- If we were to ask the 4th, 5th and 6th grade teachers to fill this out, how do you think they would answer? Adults at home?
- Does this survey raise questions you think we need more information about? What are they?
- What do people appear to know about extinction? Endangered plants and wildlife?

Activity 4. Will I Survive: An Autobiography of an Extinct or Endangered Species

OBJECTIVES

Students will be able to
1) identify specific reasons for extinction and endangerment of plants and wildlife; and
2) develop an appreciation for the hazards associated with plant and wildlife survival.

MATERIALS

Blackline Masters:
WILL I SURVIVE: AN AUTOBIOGRAPHY OF AN EXTINCT PLANT OR ANIMAL
WILL I SURVIVE: AN AUTOBIOGRAPHY OF AN ENDANGERED PLANT OR ANIMAL
EXTINCTION IS FOREVER

PROCEDURE

1. This is a library research project. Have students work in teams or individually to learn about extinct and endangered animals and plants. Three blackline masters are provided: one on endangered species and two on extinct species. Have each student choose one and complete it.

The blackline master may invite a fill-in-the-blank response. That is not the intent or will there be enough space. Students should transfer the items to another sheet of paper and develop a small research report. When they cannot find information they should indicate this. Students should also make a drawing of the plant or animal they investigated.

Extinct animals that students might investigate are passenger pigeons, dinosaurs, mammoths, bison, Arizona jaguar, Texas great wolf, dwarf emu, auks, dodos. Extinct plants include: dodo tree, mountain ebony, moth orchid. Endangered animals include: peregrine falcon, ivory billed woodpecker (status is uncertain), gray wolf, black footed ferret, grizzly bear, whooping crane, brown pelican, cougar, California condor, panda, Hawaiian (NENE) goose, humped back whales, blue whales.

What students need is access to research materials. It is important that you or your librarian begin saving a collection of brochures, articles, clippings, and information sheets so that this task becomes more meaningful with future classes. See the Resources section for other suggestions, or ask state natural resources and federal U.S. Fish and Wildlife personnel. Ask your librarian to purchase *The Doomsday Book of Animals* by David Day. This paperback is reasonably priced. It is an "illustrated account of the fascinating creatures which the world will never see again."

SECTION II. NATIONAL PARK—ON-SITE ACTIVITIES

Activity 5. What Extinct or Endangered Species Am I? [1]

OBJECTIVE
Students will be able to describe plants and animals of special interest in the park.

MATERIALS
For the Class
Masking tape
Pen

PROCEDURE
1. **Option 1.** Write the name of an extinct or endangered plant or wildlife species on masking tape. Stick it to a student's back. Park examples should be used. Indicate whether it is extinct or endangered. The student should not be able to see what species s/he is. The student then asks five to ten other students questions that can be answered only with a yes or no. Several students may be the same species.

2. After students have asked their questions, have the students form a semi-circle so that all can see, and stand one of them (or all that have the same species) with his or her back to the circle. S/he should tell the group as many things as she can about the species including which one s/he thinks it is. If the student is unsuccessful have the class help by describing its characteristics.

3. When students learn the identity of their species take some time to add interesting information about the species. Also discuss the lesson:
- When we say that an organism is extinct what are its chief characteristics?
- Can you define (endangered/extinct)?
- What if someone were to suggest that eventually all animals and plants will become extinct? S/he asks "What's all the fuss about an endangered species?" "What would you say?" "What is another way of looking at this?" "Who has another view?"

4. **Option 2.** During a trail walk tie the theme of extinction/endangered plants or wildlife to the topic of biodiversity, a walk in which you are pointing out and discussing biodiversity. From time-to-time, tape the name of an endangered or extinct species on the back of a student. Have her or him ask questions of his or her classmates that can be answered only with a yes or no answer. If the park trail passes through habitat that is similar to habitat requirements of the extinct/endangered species ask students to describe and name the habitat. Use this time to discuss such issues as species protection, reintroduction plans and problems.

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[1] Adapted from Joseph Bharat Cornell. 1979. *Sharing Nature With Children* and Linda L. Cronin and Michael J. Padilla. 1984. *Science and Children*, January.

Activity 6. Species Extinction: A Game of Life [2]

OBJECTIVE

Students will be able to describe the way humans affect game-like (random/chance) characteristics of plant and wildlife endangerment and extinction.

MATERIALS

Sock/stocking hat
Coin

PROCEDURE

1. Make a 10' - 15' diameter circle on the ground and arrange all the players on the circle.

2. Stand in the center and place the sock on the ground near you. Explain that you are a human using the earth. Ask students to name a way that humans use the earth. They are plants and animals who also use the earth. The sock is land, air and water. To survive they must grab the sock and return to the circle without getting tagged by you. The game restarts when one of the plants or animals successfully seizes land, air and water or when all the plants and animals are caught. The new human is the one who is successful. Only three plants and animals can be inside the circle at a time. Play for about five minutes.

3. Summarize and discuss the purpose of the activity. This is an attempt to help students gain awareness and understanding of the side effects of human competition for land, air and water.
- Can you name an organism that lived primarily on land or in air or water that is extinct? Endangered?
- Are extinctions random? Explain.
- Are humans responsible for extinctions? To what extent?
- What are some things humans can do to keep species from becoming endangered or extinct?

4. When finished have the students count off by two's. Flip a coin; if heads, all number one's are extinct and all two's are endangered.

[2] Adapted from *Junior Ranger Activity Guide, Voyageurs National Park* by Gary Moon.

SECTION III. CLASSROOM—POST-VISIT ACTIVITIES

Activity 7. The Advertising Game

OBJECTIVES

Students will be able to
1) research and develop a creative, informative advertisement about an extinct or endangered plant or animal; and
2) gain some insights into their own thoughts and feelings about extinct or endangered plants or animals.

MATERIALS

Newsprint
Variety of art materials

PROCEDURE

1. Have the students create a poster for an advertising campaign on an extinct or endangered species from the park they are visiting. Students can work individually or in teams.

Discuss the possibilities with students. Is a drawing or an outline/silhouette of an organism more attention getting or informative? What will make people stop and read the poster carefully? Would charts or maps be useful? How can you convince others that these issues are important? Can you use the poster to make a point about the present or the future? What idea do you want to sell? Do you want to persuade others to do something? What? Should you describe an action others can take? What one? Would a slogan be useful? (Ask students if they can name some slogans and products with which they are associated.)

2. When the work is completed create a room or hallway gallery and examine the work. Ask these kinds of questions:
- How well do the posters communicate why the issue of extinction/endangered species matters?
- What are the chief features of a poster that communicate such concerns well?
- Are there differences between extinction posters and endangered species posters? What are they?
- What do you hope people will do as a result of reading and viewing these posters?

Activity 8. "Their Day"

OBJECTIVES

Students will be able to
1) apply what they have learned in arranging a creative celebration honoring an extinct or endangered plant or animal; and
2) communicate the value of a concern about extinct and endangered plants and animals to others.

PROCEDURE

1. Plan a program in honor of an extinct species which died an unnatural death or a program in honor (and celebration) of an endangered species still with us or a celebration of a no longer endangered species (such as the alligator) or a reintroduction of a species into the wild (such as the red wolf, a species primarily extinct in the wild. The two pair released in North Carolina, had two pups, Spring 1988).

2. The class must decide these kinds of items:
- What is being celebrated or remembered?
- What is being honored?
- What makes this a special occasion, one that should be celebrated?
- How can this be made into a special occasion for the species in question?
- How this occasion should be celebrated or remembered in an "environmental" way. Ask the class whether balloons are an environmentally safe way to honor/remember an extinct/endangered organism.
- What "present" might the class give to (or in honor of) the species?
- Would learning more about an endangered organism be helpful? What would you be interested in learning? How would it help the organism?
- How could writing a letter of elected officials help an endangered organism? What would ask them to do?
- Would cleaning up a polluted site help endangered organisms? How?
- Would keeping an up-to-date list of endangered species in your classroom help?

EVALUATION

1. Each of the following terms is an important idea in biodiversity. Define each in one or two sentences. Use your own words.

Extinct

Endangered

2. Circle items that can cause a wild plant or animal to become endangered or even extinct.

Small population size	Disease	Habitat change
Predation	Collecting	Large population size
Pollution	Fear	Hunting
Habitat loss		

3. Choose one of the answers you circled in Question 2 and tell why it is an important cause of extinction.

4. Choose one of the answers you circled in Question 2 and tell why it is an important cause of endangered species.

5. What is the biggest difference between extinct and endangered?

6. Once there was no school here, just a community of plants and animals. List three changes in the community that have been the result of human activity.

7. A city now occupies the place where foxes and bears lived. They are gone now but present in the countryside. Someone suggests that this is an example of extinction. Is it? Why or why not?

8. A student has to do a report on extinction. The information is supposed to be from three different sources. Suggest three specific sources of different types useful in finding out about the topic.

9. Write a story using each word below.

Extinction	Habitat	Population	Environment
Organism	Park	Community	

10. Write natural and human causes as headings for two columns. Under each list natural causes and human causes that can cause organisms to become endangered or extinct.

11. A forest has to be cut down for timber. What do you think will happen to the plants and animals?

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I AM....

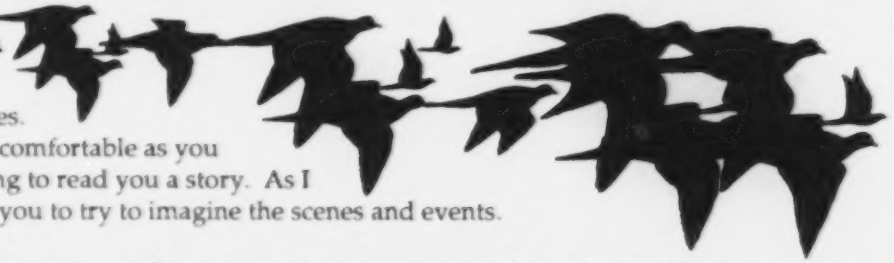
I AM a Gray Wolf (mammal)	I AM an Indiana Bat (mammal)
I AM a Florida Panther (mammal)	I AM a Grizzly Bear (mammal)
I AM a Utah Prairie Dog (mammal)	I AM an Alabama Beach Mouse (mammal)
I AM a Key Deer (mammal)	I AM a Sea Otter (mammal)
I AM a Woodland Caribou (mammal)	I AM a Fresno Kangaroo Rat (mammal)
I AM a Northern Swift Fox (mammal)	I AM a Bald Eagle (bird)
I AM a Peregrine Falcon (bird)	I AM a California Condor (bird)
I AM a Brown Pelican (bird)	I AM an Eskimo Curlew (bird)
I AM a Hawaiian Honeycreeper (bird)	I AM a Hawaiian Moorhen (bird)
I AM an American Crocodile (reptile)	I AM a New Mexico Ridge-Nosed Rattlesnake (reptile)
I AM a San Fransicso Garter Snake (reptile)	I AM a Red Hills Salamander (amphibian)
I AM a Houston Toad (amphibian)	I AM an Apache Trout (fish)

I AM a Bonytail Chub (fish)	I AM a Noonday Snail (snail)
I AM a Judge Tait's Mussel (clam)	I AM a Nashville Crayfish (crustacean)
I AM a Delta Green Ground Beetle (insect)	I AM a Smith's Butterfly (insect)
I AM a Tree Cactus (plant)	I AM a Minnesota Trout Lily (plant)
I AM a Green Pitcher (plant)	I AM a Furbish Lousewort (plant)
I AM a Prairie Bush Clover (plant)	I AM a Ruth's Golden Aster (plant)
I AM a Short's Goldenrod (plant)	I AM a Virginia Round Leaf Birch (plant)

SURVIVAL FACTORS

People are afraid of you or think you are a pest. They trap and shoot you.	Your habitat is threatened from oil/gasoline spills, ocean drilling or runoff from gas stations into wetlands, streams and ponds.
Your habitat is used for recreation—snowmobiles, off-the-road vehicles, beach buggies.	Human population growth increases.
A trapper has set out some traps and you have gotten caught in one.	Silt from logging and agriculture pollutes the water.
Your habitat is used for construction projects—highways, housing, shopping centers.	A poacher has shot you illegally.
Your marsh is drained.	A city expands and builds an office complex in your meadow.
A dam was built and the valley where you live is now deep under water.	An oil tanker has spilled thousands of gallons of oil into the ocean.
A cabin is built as a vacation home in your forest.	Chemicals used on lawns have been washed into the water.
A fire has burned your forest.	Pesticides have polluted the water.
A timber company has clear cut an area where you find food.	An oil company has paid to test the effect of oil drilling on an area where you live.
A timber company has cut an area in patches leaving critical habitat for you.	New zoning allows development nearby but protects your critical habitat.

MARTHA



Close your eyes.
Relax. Get as comfortable as you
can. I am going to read you a story. As I
read it I want you to try to imagine the scenes and events.

When European explorers first came to America they saw large flocks of birds known as passenger pigeons. There were millions and millions and millions of them. The passenger pigeon was a large and graceful bird. Including its long tapering tail it was about 16 inches long. The head and back of the male were a glossy bluish gray. Underneath, the breast was red. The female was light brown above and her breast was gray. They had sparkling red eyes. Some have described the eyes as "bright, fiery orange." They nested in northern forests in the summer and flew south in the fall. They usually laid only one egg on a flimsy platform of sticks and twigs someplace in a tree.

Usually more than a hundred other passenger pigeons nested in the same tree. Sometimes there were so many nests that limbs would break and fall to the ground. Passenger pigeons nested in large groups that covered large areas. A nesting area found in Michigan was 28 miles long and three to four miles wide. These were loud noisy birds. They sounded like a huge army of bullfrogs. Their droppings killed the plants underneath and they stripped the trees of their leaves. In describing their nesting area, one person said it looked as though the forest had been struck by a tornado.

The food of the passenger pigeon consisted mainly of beechnuts, acorns, berries and seeds. It was a fast flyer and could fly a mile a minute. It was known as the "blue meteor." Passenger pigeons flew in enormous flocks and could even block out the light of the noon-day sun, "their wings roaring like thunder."

They were also very tasty. Expert hunters killed large numbers. One hunter killed 1,200 a day over a week-long period. Upright nets were often used to capture them. Pigeons struck tree nets with such force that they either fell dead to the ground or became entangled in the netting. Pigeon-netting was such a common practice that almost every town was equipped to net pigeons. At night, they could be quickly prodded from their roosts with long poles. They were so numerous that some people hunted them with sticks or stones.

Trappers caught thousands. These pigeons were kept in boxes and released to be used as living targets for shooting practice. Grain was soaked in alcohol and used as bait. As pigeons lay helpless, fluttering on the ground, hunters could walk among the trees and fill their bags. Trees were cut down so that nestlings could be captured for market.

The shooting and hunting continued for years. When asked whether these birds needed any protection, officials would say no, there are millions of them. However, the United States was growing. There were more and more people. Railroad ties were beginning to crisscross the land. Forests were being cut down for timber and to clear the land for farming. The pigeons had to find new routes for migrations. Their food, acorns, beechnuts and wild fruit became harder and harder to find. Gradually the flocks of pigeons became smaller and smaller. The flocks were scattered widely over the United States and Canada.

Finally protective laws were passed prohibiting the hunting of passenger pigeons. And people thought they were safe, but each year fewer and fewer pigeons were seen. Their habit of producing only one egg at a time did not result in many offspring. On September 23, 1907, the last passenger pigeon in the wild was shot.

But there were still some kept in zoos. And there was hope that they would survive. However, even in zoos they didn't produce enough eggs. The older birds died faster than young birds hatched.

Eventually there was only one left. Her name was Martha, and she lived in the Cincinnati Zoo. Not much was known of Martha's past. She probably was born from a pair of captured pigeons in Wisconsin. She arrived at the Cincinnati Zoo in 1902. Her age is a mystery. No one knows for sure how old she was when she died. She might have been 14 or as old as 29.

Martha is now mounted in a display case at the Smithsonian Institution in Washington, DC. The label on the museum reads: "Martha, Last of her species, died at 1 p.m., 1 September 1914, age 29, in the Cincinnati Zoological Gardens."

When you are ready, open your eyes.

A QUESTIONNAIRE ON EXTINCTION AND ENDANGERED PLANTS AND WILDLIFE

1. Is the threat of extinction worse today than it has even been in history?

___ Don't know ___ Yes ___ No

2. Does our state have any endangered plants or wildlife?

___ Don't know ___ None ___ Yes. If yes, name one or more:

_____

_____

_____

_____

3. Name as many extinct species as you can.

_____

_____

_____

4. Do all wild plants and wildlife have the right to a place on earth or must some have to disappear for human needs? ___ Yes ___ No

5. Suppose a project were to endanger a wild plant or animal. Check (✔) if you would approve the project if it endangered:

	Yes	No
a butterfly	☐	☐
a fish	☐	☐
a spider	☐	☐
a crocodile	☐	☐
a plant	☐	☐
a snake	☐	☐
a bird	☐	☐
a large predator like a mountain lion or wolf	☐	☐

WILL I SURVIVE: AN AUTOBIOGRAPHY OF AN ENDANGERED PLANT OR ANIMAL

Endangered Species Name _____

1. I have lived on Planet Earth for _____
2. Draw a map or write the places (range) on Planet Earth where I am found

_____

3. Scientists know these things about me: _____

_____

4. My job in the community/ecosystem where I live is _____

_____

5. Scientific words to describe my profession in a community are: _____

_____

6. I am endangered because _____

_____

7. Organizations involved in making sure I don't go extinct are: _____

_____

8. The benefits I provide to humans are: _____

_____

9. Things people can do to help me are: _____

_____

10. The chances of my survival are _____

_____

WILL I SURVIVE: AN AUTOBIOGRAPHY OF AN EXTINCT PLANT OR ANIMAL

Extinct Species Name _____

1. I have lived on Planet Earth for _____
2. The places (range) on Planet Earth I was found were _____

_____

4. Scientists know these things about me: _____

_____

5. My job(s) in the community/ecosystem were _____

_____

6. I was larger than a _____ and smaller than a _____
7. A description of me would have included _____

_____

8. How did my parts work together to make me successful in my environment?

_____

_____

9. People believe I became extinct because _____

_____

10. My extinction was natural (not caused by humans) or unnatural (caused by humans)

☐ Natural ☐ Unnatural

How do you know? _____

Unit 3

THE ROLE OF NATIONAL PARKS IN MAINTAINING AND PRESERVING BIOLOGICAL DIVERSITY

OVERVIEW

Students learn about the role of national parks in preserving biodiversity through process oriented investigations, planning, discussion and writing to students near another national park.

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TEACHER BACKGROUND

Because of the role they play in conserving lands under their jurisdiction, national parks are often the last sanctuary for many plants and animals. The role of the National Park Service as a protector of biological diversity is emphasized in the 1987 report of the Director's Task Force on Biodiversity which says, "National parks within or containing natural areas should, first, protect biological diversity and underlying processes that maintain and generate natural biological diversity. Just about any park can be made adequate for preserving tourism, but no national park can be made adequate for preserving biological diversity without a superior investment in protection.

Many potentially important plants and animals exist within habitats protected by national parks. They are important for their economic, as well as aesthetic value. Their contribution to out daily welfare is tremendous: food and drink, medicines and pharmacueticals, industrial products, transportation, energy, research, construction. We know surprisingly little about most of the earth's plants and the direct economic benefits we might enjoy from them. Yet, we are rapidly eliminating them. Presently, one species each day is being eliminated from the face of the earth and that number is only expected to increase. Through the establishment of national parks, it is possible to assist in maintaining biological diversity in the natural world and slow down that elimination.

Yet, scientists and park professionals realize that all of their efforts to preserve habitats and protect diversity within park boundaries will not be enough. External forces from around the world have a tremendous impact on what happens within national parks.

It is for this reason that this unit will examine the role that national parks play in maintaining and preserving biological diversity. More significantly, it will show your students why that role is an important one.

SECTION I. CLASSROOM—PRE-VISIT ACTIVITIES

Activity 1. Develop a School Site

OBJECTIVES

Students will be able to
1) make a map, develop a map key and measure a study site;
2) identify ways that people can change their environment;
3) work cooperatively in groups on a common task; and
4) to understand the ways in which national parks manage for biodiversity.

MATERIALS

For Each Team
6-10 colored markers/crayons
Scissors
1 sheet of black paper
Plastic or masking tape
Glue

Blackline Masters:
A SCHOOL SITE

PROCEDURE

1. Divide the class into teams of three students.

2. Distribute copies of the blackline master, A SCHOOL SITE (page 3-5) to each team.

3. Distribute an 8 1/2" x 11" piece of colored construction paper, tape, and a pair of scissors to each team.

4. Explain to the students that the blank sheet of construction paper will be a new school site that they will design. Have them cut out the items on the blackline master, A SCHOOL SITE. Tell them to arrange the items on the construction paper in a way that will use the site most effectively. One criterion in arranging the site is that they must create a protected area that will allow for biological diversity. All the items must be fit on the piece of construction paper.

5. When they are finished display the reports where everyone can see them. Discuss the advantages and disadvantages of each and record the major advantages/disadvantages of each plan on the chalkboard.

6. Summarize the work by using the team maps to discuss these kinds of questions:
- Did all groups come up with the same plan? Why or why not?
- In what ways do you think humans have affected the biodiversity of this area?

•What is the most common color before the plan? After the plan? Which features do they represent?
•Is any pollution produced on this site? What kinds? How might it affect biological diversity?
•What do you think this place will look like in the future (fifty years from now)?
•Will its biodiversity increase, decrease or be about the same? How do you know?
•What are some possible effects on the biological diversity from land uses immediately surrounding the school site?
•Suppose you wanted this school to be known as "Biological Diversity Elementary School." It would be a place where people could come and learn about biological diversity. Are there land uses you would eliminate? Change? Which one(s)? What are your reasons? What kind of education and beliefs would be emphasized in such a school?
•How are problems that you had in planning your site similar to the problems national parks have in preserving biodiversity?

7. Save the plans. Students will use them again when they return from the park.

EXTENSION

Provide students with an additional sheet of paper to create new items not on the blackline master; A SCHOOL SITE. These may include items that are found at your school.

Activity 2. Conserving the Parks

OBJECTIVES

Students will be able to
1) list three ways biodiversity is preserved in national parks; and
2) list three threats to biological diversity in national parks.

MATERIALS

For Each Team
1 Manila folder
Dice
20 Index cards, 3" x 5"
Map of a national park (available at the park visitor center)

Blackline Master:
GAME CARDS

PROCEDURE

1. On an open manila folder have each group of two to four students draw the outline of the national park you will visit. Use the map you got from the park visitor center. Leave enough space so that another parallel outline about 2 inches outside the original one can be drawn. Include natural features found on the park map. Divide the space between the two outlines into 60 to 80 spaces. Designate a beginning and end point. Most game boards use a clockwise movement. It will help if the start square has a large arrow to indicate the direction of movement around the board.

2. Use about 20 cards from those provided on the Blackline Master, GAME CARDS. As a result of reading, research and a visit to a national park, encourage students to create their own biodiversity statements and add them to the suggestions listed.

3. To play the game, shuffle the cards and place them face down on the game board. Each player rolls a die with the player rolling the highest number starting the game. If an even number is rolled, the player moves forward that many spaces. If an odd number is rolled the player selects a statement and moves either forward or backward depending on the nature of the situation. The first player to reach the goal of biological diversity wins the game. The player has to roll the exact number to land on the winning space.

5. Discuss the game with the class and ask students to comment on these questions:
•Why are national parks so important in preserving biological diversity?
•In 1854, Chief Seattle said, "If all the beasts were gone, we would die from a great loneliness of spirit.... All things are connected. Whatever befalls the earth befalls the children of the earth." What does the word "connected" refer to? What arguments can you offer to show that we are connected to plants and animals? What did Chief Seattle mean by: "Whatever befalls

the earth befalls the children of the earth?" How would Chief Seattle say the natural environment is to be treated?

- What are some things that happen to biodiversity as a result of people? If students list all bad things ask whether there are any good things.
- Are most of the factors affecting biodiversity biotic or abiotic? (Examples of biotic factors are: presence of other living organisms, odor or sounds made by other organisms, and removal of something by another organism, e.g., leaves and twigs eaten by deer. Examples of abiotic factors are: rain, temperature, clouds, light, and weather.)

SECTION II. NATIONAL PARK—ON-SITE ACTIVITIES

Activity 3. Flash Card Circle Game [1]

OBJECTIVE

Students will be able to describe the interdependence of human/plant/animal biodiversity.

MATERIALS

For Each Team

A set of index cards
2 felt tip markers (broad and fine)

PROCEDURE

1. Divide the class into groups of six to ten players each, depending on the habitat you choose and the age and ability of the students. If possible, play this game in habitat that an endangered animal or plant might be found in and use that organism.

2. Give each player a prepared 3" x 5" card with two names on it: a.) a species in the habitat's food web (large, bold print); and b.) a species it is looking for (small, fine print).

An example of a six player sequence is:

GREAT HORNED OWL (rabbit)	RABBIT (raspberry bush)	RASPBERRY BUSH (deer)
DEER (wolf)	WOLF (human)	HUMAN (great horned owl)

The links are not strict food chain relationships; they are interdependent relationships. Each player is to keep both names secret. One player receives a card labeled HUMAN.

3. The players act out the organisms in bold print on their card and look for the organism in fine print. When they think they have found it, they grab the player's hand, who flashes his/her card. If it's right, they continue holding hands. The search continues until the group is linked in a circle.

4. Discuss the game. Make some points about the management of biodiversity in the park or the importance of parks in preserving biodiversity. What is the human doing in this game anyhow? How are wolves and humans dependent on each other?

---

[1] Adapted from: Terry Orlich. 1978. *The Cooperative Sports and Game Book*. Pantheon Books, New York.

Activity 4. Free Ecosystem Services?

OBJECTIVES

Students will be able to
1) describe the services natural ecosystems provide;
2) the importance of national parks in preserving biological diversity; and
3) the responsibility that humans have in preserving biological diversity.

MATERIALS

3" x 5" cards, class set
Yarn or string

PROCEDURE

There are many reasons for pursuing biodiversity. One is the ecosystem services all the things in that ecosystem.

1. Prepare a set of 3" x 5" cards using ecosystem services from the examples provided by your park and loop yarn through them.

2. Give each team of two a card. Tell them that they are to find plants and animals that do the jobs/tasks. They hang or place cards on or near the object that performs the job. Teams can use evidence as well as the real object (For example, animal trails, scat, dens. . . Emphasize safety concerns.

Examples of Cards	Examples of Answers
Garbage hauler	raptor, ants, wasps
Construction worker	beaver dam, ants, spider web, bird nest, animal den
Demolition worker	decomposers, earthworms, soil organisms
Air conditioner	plants (vegetation makes a temperature difference)
Cleaner/Cleaning Product	stream/lake (self-cleaning)
Highway/Road/Path	deer path, mouse tunnel, insect tracks (leaf miner, bark beetles)
Organic Farm	almost everything!
(evidence of food use)	berry patches, sunflowers, browse, holes in leaves
Drug Store/Pharmacy	molds, witch hazel, jewelweed, blue violet,
(First Aid kit)	rose hips, aspen
Sponge	soil
Manufacturer	plant (food and oxygen)
Broom	wind
Storage Facility	seeds, soil (water)
Filter/Steamer	soil
Air Cleaner	plants

4. When they are done use this opportunity to discuss the importance and responsibility of preserving biodiversity. Emphasize the interdependence within natural systems and our dependence on them. Nature's services appear to be free, e.g., wind, it's a broom (or fan).

When we add pollutants to the air that cause acid rain or ozone, leaves are damaged. This may make the plant less healthy. This kind of air pollution may also cause tree death, decrease the growth, make plants more susceptible to disease and pests. Foliar injury has been documented at a number of National Park Service (NPS) units. If you are at one of them point out examples.

You may want to use lichens as an example of one of nature's meters or dials. Tell students that lichens are indicators of acid rain (sulfur dioxide). Depending on where students are from, this can be a good opportunity for you to discuss lichen biodiversity in the park compared to what students can see at home. It is also a chance to talk about extinction (local).

Milkweed is another of nature's meters; it's sensitive to ozone and has been used as a bioindicator in a number of NPS units.

5. If you want, summarize with these questions:
- How is garbage handling in a natural community different from garbage handling in a city / small town? What are some things we can learn from nature about our garbage problem?
- What are some ways we depend on nature?
- Why are natural areas important?
- In what ways are human communities like natural communities? Different from natural communities?
- What are some reasons biodiversity is important?
- What are some ways a decrease in biodiversity might affect us?

SECTION III. CLASSROOM—POST-VISIT ACTIVITIES

Activity 5. "There's No Place Like Biome"

OBJECTIVES

Students will be able to
1) obtain factual information about biological diversity in another park; and
2) describe the climatic, landscape, plant and animal characteristics of a national park biome.

MATERIALS

For the Class
Map of the United States
Art materials: markers, crayons
Pencils
Paper
Envelopes
Stamps
Optional: Map of biomes
Guide and Map—*National Parks of the USA* (available at national parks)

For Each Team
Blackline Master: THERE IS NO PLACE LIKE BIOME
Pencils
Paper

PROCEDURE

1. Your class has learned a great deal about some of the issues, problems and responsibilities associated with the preservation of biological diversity. Students may be interested in sharing what they have learned about biological diversity and learning about the preservation of biological diversity in other national parks.

Post the guide and map, *National Parks of the USA*. For more information see RESOURCES: National Park Service. Ask students to select a park to write to for more information about biological diversity.

The questions students ask should be their questions. They might want to know what organisms are endangered in a particular park and what is being done to preserve them. Based on their experience, they may wonder about how trails are laid out that teach visitors about biological diversity, what problems the park has in preserving biological diversity, etc.

What is the biggest threat to biological diversity in the park and what is being done about it? What plants and animals are endangered? What do park rangers or managers or scientists do to preserve biological diversity?

2. North America can be divided into several large areas of plants and animals. Each is quite distinct and contains characteristic plants and animals. These areas are similar in others ways, too: temperature, rainfall, amount of sunlight, and soil characteristics.

Each of these regions is called a biome. Science textbooks vary in the number of biomes they describe. It is usually six or seven. They are tundra, tiaga (TY guh), deciduous forests (temperate forests), rain forests, scrub forests, deserts and grasslands. Discussions about biomes are usually at fifth or sixth grade.

Distribute copies of THERE IS NO PLACE LIKE BIOME. Have students use available classroom and library materials to complete it.

3. Discussion

- Do any animals in the biome you live in also spend part of their time in another biome?
- Have you ever visited another biome? Would you like to live in it? Why or why not?
- If you visited the national park in (name another season), would this make a difference in the plants or animals you saw?
- Do you think seasons have any effect on biological diversity? How do you know? How could you find out?

Activity 3. Design Your Own Trail

OBJECTIVES

Students will be able to
1) desig a biological diversity nature trail;
2) describe and interpret various things about biological diversity; and
3) describe ways of showing and explaining biological diversity to others.

MATERIALS

For Each Team
Blackline Master: BIOLOGICAL DIVERSITY TRAIL GUIDE
Pencils
Map developed in Activity 1

PROCEDURE

1. Divide the class into its original work groups. They are now park naturalists. Give them the plans and maps they developed in Activity 1. Each team is to draw a line indicating a path for a nature trail that promotes biological diversity. It is to be more-or-less circular, that is, it begins and ends at the same place. The biological diversity trail should have from four to six stops or stations on it where visitors could learn something about biological diversity. Students should develop and number these stops on their maps.

2. Distribute copies of the blackline master: BIOLOGICAL DIVERSITY TRAIL GUIDE. For each of the stations, students should tell what topic would be emphasized and how they would interpret it to others. If it is a sign, include what the sign would say, or tell what the interpreter would do or have you do.

3. When everyone is finished, post the maps, the BIOLOGICAL DIVERSITY TRAIL GUIDES, and have each team present their trail to their classmates.

4. Help them to think about their work by asking these kinds of questions:
- How is a biological diversity trail on a school site like a similar trail in a national park? Different?
- How could a biological diversity trail on a school site be made more like a biological diversity trail in a national park?
- What are some fun ways to learn about biological diversity?
- How could you determine what people learned about biological diversity by using your trail?
- What is the most important thing people should know about biological diversity?

EVALUATION

1. What are the services that plants and animals provide for us?

2. What are two ways that parks preserve biological diversity?

3. True or False. Once a plant or animal becomes extinct in a park, it can sometimes be re-introduced.

4. True or False. Pollution is a threat to biological diversity?

5. What is the name of the biome in which you live?

6. Choose. What would you do in the following situation and tell why?

•A population of large birds lives in a park. They eat small birds and are endangered. The small birds depend on plants that are not native to the park.

☐ Get rid of the plants.
Reason:_____

☐ Leave the plants in the park.
Reason:_____

7. You are visiting a national park. A number of animals in the park are wearing bright ear tags. You know that this organism is endangered. A person complains to you about this. S/he says, "This park is just like a zoo. The animals don't seem wild." What is something you might tell him or her about why scientists are doing this?

_____

_____

_____

RESOURCES

CLASSROOM

Golden Guides. Golden Press, New York, NY. Titles include: *Birds, Butterflies and Moths, Fishes, Flowers, Fossils, Insects, Insect Pests, Mammals, Mushrooms, Reptiles and Amphibians, Seashores, Spiders, Trees,* and *Weeds*. There is also a series of Golden Field Guides.

GENERAL

Backyard Wildlife Habitat Program, National Wildlife Foundation, 1412 Sixteenth Street N.W., Washington, DC 20036.

Alston Chase. 1986. *Playing God in Yellowstone*. Atlantic Monthly Press. Boston/New York.

William C. Everhardt. 1983. *The National Park Service*. Revised Edition. Westview Press, Boulder.

Laura Martin. 1987. *A Bit of Wilderness in Your Own Backyard*. National Wildlife:July/August.

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William Penn Mott, Jr. 1986. *Library of the Wild—The National Parks: A Fragile Treasure of Species That Can Keep the Planet Alive and Well*. National Parks: January/February.

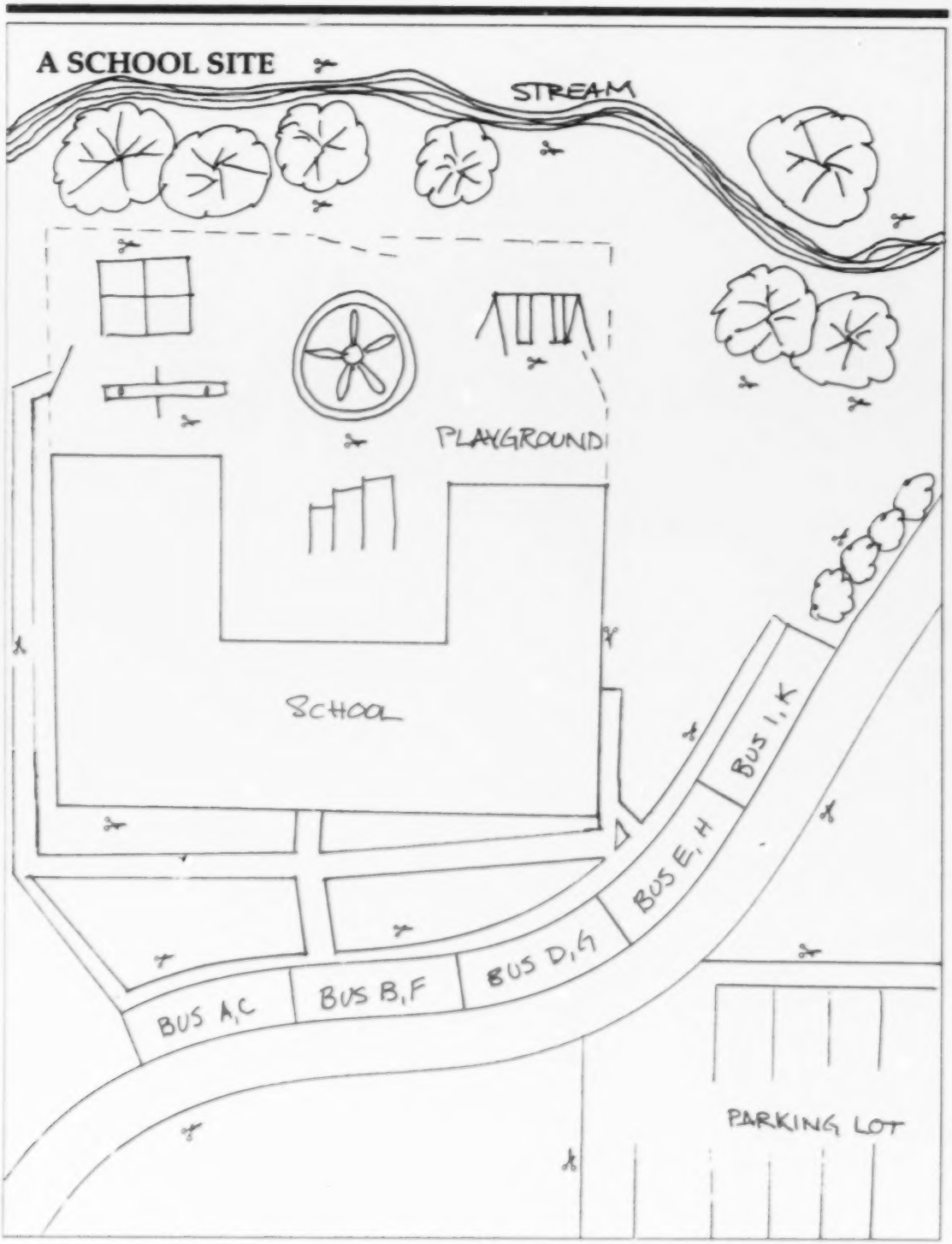
The Nature Conservancy. 1975. *The Preservation of Natural Diversity: A Survey and Recommendations*. Washington, D.C.

Joseph L. Sax. 1980. *Mountains Without Handrails: Reflections on the National Parks*. University of Michigan Press, Ann Arbor.

NATIONAL PARK SERVICE

National Park System Guide and Map. Office of Public Affairs, Washington, DC. (Available at parks and NPS Regional Offices.)

The National Parks: Index. Superintendent of Documents, U.S. Government Printing Office, Washington, DC 20402.


A SCHOOL SITE
STREAM
PLAYGROUND
SCHOOL
BUS I, K
BUS E, H
BUS D, G
BUS B, F
BUS A, C
PARKING LOT

GAME CARDS

Scientists have money to do research on endangered organisms. *Go ahead 3 spaces.*	Management for endangered species is explained to visitors. *Go ahead 3 spaces.*
Maps of all features of the park—water, soil, land use—are completed. *Go ahead 2 spaces.*	Adjacent land owners protect non-park habitat important to endangered species. *Go ahead 3 spaces.*
There is not enough money to fund a plant and animal survey in the park. *Go back 4 spaces.*	There are not enough park personnel to protect biological diversity. *Lose your turn.*
Air pollution is a constant problem in the park. *Go back 4 spaces.*	Not enough is known about the natural history of an endangered species. *Go back 4 spaces.*
Use of pesticides held to a minimum. *Go ahead 3 spaces*	Curious visitors disturb an endangered organism. *Lose your turn.*

Cooperate with state, federal and international organizations to preserve park biodiversity. *Go ahead 3 spaces.*	Land development along park boundariesin such a way as to destroy critical habitat. *Go back 3 spaces.*
A survey to learn all the plants and animals living in the park is completed. *Go ahead 4 spaces.*	As much as possible, nature is relied upon to maintain park biological diversity. *Go ahead 3 spaces.*
Poaching in park. *Go back 2 spaces.*	A migratory bird winters in an area where its habitat is being destroyed. *Move back 4 spaces.*
Natural resources come first. Visitors are restricted to certain areas of the park. *Go ahead 3 spaces.*	Visitors trample vegetation, cause soil erosion and water pollution. *Go back 3 spaces.*
Volunteers assist in restoration of critical habitat. *Go ahead 3 spaces.*	Mining and oil/gas exploration affect air quality and plant and wildlife habitat. *Go back 2 spaces.*
Non-native plants are removed. *Go ahead 3 spaces.*	Cooperate with a zoo or plant garden to return organisms to their natural habitat. *Go ahead 3 spaces.*

Park needs additional staff to manage and protect endangered habitats. *Go back 3 spaces.*	Project to develop and maintain a native plant nursery is funded. *Go ahead 2 spaces.*
Rare endangered plants removed from park. *Go back 3 spaces.*	Local Industry regularly collects information to determine changes in air and water pollution. *Go ahead 3 spaces.*
Park has user fee; money to be used to expand their work on endangered species. *Go ahead 2 spaces.*	Not enough understanding of park habitats to make decisions about managing them. *Go back 3 spaces.*
Computerized data bases on endangered plants and animals are improved. *Go ahead 2 spaces.*	A native organism absent from the park is scientifically reintroduced. *Go ahead 3 spaces.*
Native predator reintroduced. *Go ahead 3 spaces.*	Non-native animals destroy native plants and wildlife. *Go back 3 spaces.*
Unnatural regulation of water level outside park destroys fish, water birds, and aquatic plants *Go back 3 spaces.*	Returning habitat to its former condition saves an endangered organism. *Go ahead 3 spaces.*

Lands added to National Park System that include new kinds of habitats. *Go ahead 3 spaces.*	In land purchases for park biological diversity of the habitat is taken into consideration. *Go ahead 3 spaces.*
Conduct yearly surveys to determine numbers of rare plants. *Go ahead 3 spaces.*	The park informs surrounding land owners about endangered species on their land and the importance of protecting the biological diversity on their property. *Go ahead 3 spaces.*
Programs to teach the public how we depend on biological diversity for food, medicine and other products. *Go ahead 3 spaces.*	Where necessary habitats are actively managed to protect species. This may include planting food, burning, control water levels and possibly killing natural predators that are present in high numbers. *Go ahead 3 spaces.*
Citizens take pride in the land and its organisms everywhere. *Go ahead 3 spaces.*	There is not enough information on habitat needs for many endangered organisms. *Go back 4 spaces.*
Pesticide use outside park causes water and land pollution with loss of native plants. *Go back 4 spaces.*	Habitat conditions for many parks before they were changed by early settlers is not known. *Go back 3 spaces.*
Organisms introduced by humans (exotic species) are removed whenever practical. *Go ahead 2 spaces.*	More and more humans have the ability to change the ecosystems, weather and climate. *Go back 3 spaces.*

Parks became more and more like islands as the land outside parks is developed. *Go back 4 spaces.*	There is not enough money to do everything that needs to be done. *Go back 4 spaces.*
A common organism that uses the same habitat is trapped and removed to give an endangered species a "headstart." *Go ahead 3 spaces.*	Park staff write newspaper articles about endangered species and why they are important. (Endangered grey bats that live in four caves consume "nearly a million pounds of insects in Alabama and Tennessee each summer.") *Go ahead 2 spaces.*

THERE IS NO PLACE LIKE BIOME

NAME _____

1. In what biome is the national park you visited? _____

2. What is the biome of this national park like in terms of :

Plants _____

Animals _____

Temperature _____

Rainfall _____

Physical Characteristics _____

3. In what biome is the national park to which you wrote? _____

4. What do you think it is like there? _____

_____

_____

5. Use the scale on a map to find how far your biome is from the biome of the national park you wrote. If in the same biome use the scale to measure how far it is from your home to the national park.

_____

6. Think about the boundary between two biomes. Suppose someone sent you a collection of pictures taken in the area between biomes. What plants and animals would you expect to find there?

_____

7. Write and illustrate a story or poem told by a plant or animal that lives in the biome of the national park you visited. The theme should be related to biological diversity.

_____

BIOLOGICAL DIVERSITY TRAIL GUIDE

TEAM MEMBERS _____ _____

_____ _____

_____ _____

TOPIC	INTERPRETATION
STATION 1	
STATION 2	
STATION 3	
STATION 4	
STATION 5	
STATION 6	

Unit 4

BIOLOGICAL DIVERSITY: ITS VALUE IN $$$ AND SENSE

OVERVIEW

Students learn how we use wild plants and animals to produce the material objects we use and which sustain and enrich human life. They do this through research, games, and interpretive activities.

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TEACHER BACKGROUND

Of the estimated 350,000 different types of plants about 80,000 are believed to have food value. Of these, around 3,000 plant species have been used for food during human history although only 150 have been cultivated on a large scale. Today our world food supply depends on only a few crop plants. For example, corn, wheat and rice produce approximately two-thirds of the total world grain crop. These plants depend on wild relatives or resistant strains to maintain resistance to disease. There is concern that the wild stocks may not be available. Lesser known plants may provide us new, more productive or more environmentally sound types for generations to come.

Teosinte, a wild but extremely rare relative of corn recently discovered in Mexico, may provide us with genetic materials for producing a new form of perennial corn. If this wild variety can be successfully cross-bred with modern corn, farmers may someday be able to grow a type of corn which does not require annual planting!

Today, about half the world's medicinal compounds are derived from plants. In the U.S., almost all plant-derived drugs come from 41 kinds of plants, of which only 5 are native. The value of these drugs represents $20 billion a year in the United States and $40 billion worldwide. At least eight new drugs from plants have been introduced to the U.S. prescription drug market since 1954. Perhaps the best known of these products is penicillin, a close relative of common bread molds. The Chinese recognized the medicinal value of molds for curing festering ulcers as long ago as 2000 BC, and ancient Egyptians often applied moldy bread to open wounds.

Animals also contribute to medicine. Bee venom is used in the treatment of arthritis. Venom from a Brazilian snake produces a drug which helps control high blood pressure. Some snails and the American Bison do not contract cancer; an understanding of how this works is very important.

When the space shuttle Enterprise returned from its historic precedent-setting mission, the first portion of it to touch earth again was made from natural materials. Aviation tires are made almost exclusively from natural rubber, as it has been found that this form of rubber is more durable, elastic and heat resistant than synthetic rubber.

Many naturally derived products will also play an important role in the future, as petroleum based materials become scarce or go up in price. Ethanol derived from corn, sorghum, and sugar cane may well be a future fuel alternative. Rayon, derived from renewable forest products, may also rise in popularity for producing garments. Jojoba, a desert plant, provides a lubricant nearly equivalent in quality to oil from the endangered sperm whale. It also provides high quality waxes. By maintaining biological diversity in our natural world we are protecting a wealth of future products that have yet to be discovered.

SECTION I: CLASSROOM—PRE-VISIT ACTIVITIES

Activity 1. From Nature to You

OBJECTIVES

Students will be able to
1) understand that plants and animals are a key factor in our daily lives; and
2) identify foods that are derived from wild plants and animals.

MATERIALS

For the Class
Tape/glue
Markers
Butcher paper

PROCEDURE

1. Have each student bring 6-7 product labels from home that contain materials made from plants or animals. These products may be found in the kitchen, bathroom, barn, basement, or garage. Some key words for medical products are: gums, aloe, ephedrine, mentha/menthol, thymol and algins. Some other key words include: pyrethrins, vegetable dyes, gums, resins, tannins, latexes, carnauba.

2. On three large sheets of paper about 6 feet long write one of the following headings: FOOD PRODUCTS, MEDICAL PRODUCTS, and OTHER PRODUCTS.

3. Have students tape the product labels to the appropriate sheet.

4. When all of the labels are taped to the sheets ask students these kinds of questions:
- Do we use more animal or plant products?
- What products contain materials from the ocean? The forest? The desert? The tropics? From your part of the country?
- What are some ways that plants and animals are important to us?
- What would happen to these products if these plants and animals no longer existed?

Activity 2. We Do Not Live By Bread Alone

OBJECTIVE
Students will be able to show, through drama, several ways plants and animals affect people's lives.

MATERIALS
Art Materials, construction paper, markers/crayons, butcher paper, scissors, glue, tape
Blackline Master: THE VALUE OF CONSERVING WILD PLANTS AND ANIMALS

PROCEDURE
1. Give students a copy of the blackline master, THE VALUE OF CONSERVING WILD PLANTS AND ANIMALS.

2. Divide the class into teams of 4-6 students. Ask each team to read the blackline master and choose the topic they like best. Each team will put on its most inspired performance of the topic they choose.

3. Give students time to create a story line, to decide who will play which parts, and to create props. Props should not dominate the play or take an unnecessary length of time to develop. Have each team prepare a brief description of the play. It should also include a brief description of the organism, its importance to human welfare, what it means in terms of dollars and cents, and why all wild plants and animals are important.

4. Ask these kinds of questions to summarize the work.
- What are some ways that our lives are made better by plants and animals?
- All plants and animals have value in their habitats. They have jobs to do and lives to live. However, from an economic point-of-view many of them have no value. Why is this? (They are not priced by a market system, they are not given a money value.) We attach prices to many things. What are ways we could attach prices to natural things? If we did, do you think we would pay more attention to them when we made decisions about building a dam or clearcutting a forest?
- Some people argue that plants and animals have a right to exist for their own sake. Do you think that adding an economic argument as a reason for their survival improves their chances of survival?

SECTION II: NATIONAL PARK—ON-SITE ACTIVITIES

Activity 3. Nature's Medicine Cabinet

OBJECTIVES

Students will be able to
1) list contributions that plants make to our daily lives in the form of medicines and drugs; and
2) describe threats to biological diversity.

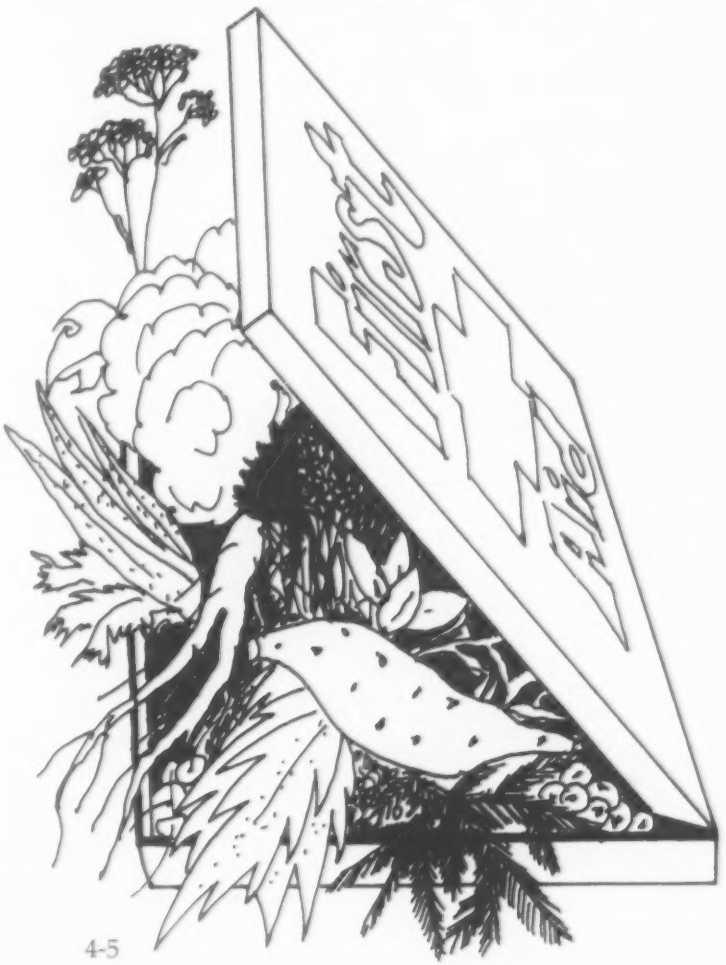
MATERIALS

First aid kit

PROCEDURES

1. Pack some of the items listed below in a first aid kit and take the students on a hike.

Antiseptic soap:
prickly cedar
Antismoking pills:
lobelia
Arthritis medicines:
Mexican yam
Aspirin:
willows (salacin); meadowsweet (salicyclic acid)
Athlete's foot cream:
castor oil plant (undecylenic acid-anti-fungal compound)
Burn cream:
aloe
Camphor:
(camphor tree); cold sores, Campho-phenique
Castor oil: *castor oil plant (food poisoning)*
CNS Stimulant:
caffeine (tea/coffee)
Cough drops:
Japanese mint/corn mint
Cough drops/lozenges:
gum arabic tree (binding agent)
Cough syrup/nasal sprays:
Ephedra spp; joint fir (ephedrine)
Cough syrup/drops:
licorice



4-5

Cough medicines: *cherry bark*
Fishliver oil: *codfish (vitamin A and D therapy)*
Gauze: *cotton plant*
Head/body lice: *pyrethrins (Rid)*
Insulin: *pancreas of hogs (diabetes)*
Ipecac syrup: *cephaelus ipecacuanha (induce vomiting, food poisoning)*
Laxatives: *psyllum from plantain seed husks (Metamucil, Syllact)*
Migraine headaches: *ergotamine from ergot fungus (Cafergot tablets)*
Mouth ulcers/canker sores *goldenseal*
Ointments for rashes (e.g., diaper) and sores: *Peruvian balsam/Indian balsam*
Pain: *codeine (Tylenol/A.P.C./Emprin with codeine)*
Pink-eye: *Caribbean sea sponge (Ara A)*
Salves, ointments: *pine*
Thymol: *garden thyme (antiseptic)*
Tincture of benzoin: *benzoin tree (vapor inhaled for bronchitis/laryngitis; antiseptic; painted on skin to aid sticking of dressings and tapes, topical protectorant)*

2. If you can, point out plants along the trail that have been used for folk or modern medicine.

3. While on the trail, hold up some of the items found in the first aid kit you are carrying and ask students which products are from plants/animals.

4. Ask students to name any other medicine that comes from plants/animals (see list above).

5. End the activity by dividing the class into groups of 5 students each. Have them:
- Select a plant along that trail that could have future medical properties.
- Decide what medicinal properties it has and what it will cure.
- Tell how we can assure that such plants in unprotected areas can be protected for future use.

Activity 4. Witch doctors

OBJECTIVES

The students will be able to
1) identify a way to find plants as sources of potentially useful medicines; and
2) describe some of the benefits and problems with one approach to finding them.

MATERIALS

Natural Object

PROCEDURE

1. Choose one student to be the witch doctor and another to be the modern doctor. Have the remaining students form a circle and place their hands behind their backs. Each student in the circle represents a different kind of plant. Place the modern doctor in the center of the circle and the witch doctor outside the circle.

2. Give the witch doctor a small natural object found in the park. Be sure to select an object such as a fruit, nut, or seed that would not damage a plant if it were picked. It symbolizes folk medicine. As s/he walks around the circle s/he says, "I know a plant which modern medicine seeks. Can the good doctor find it in my medicine chest?" After s/he has secretly left the folk medicine in the hands of one of the plants s/he stops. The doctor must then guess which plant has the medicine.

3. The doctor gets one guess. If correct s/he becomes the witch doctor, the witch doctor becomes a plant and the plant with the folk medicine becomes the doctor. If the doctor is incorrect, s/he becomes a plant, the plant with the folk medicine becomes the next doctor, and the witch doctor hides the folk medicine again. If the witch doctor successfully hides the folk medicine from the doctor three times, s/he becomes a plant and chooses a new witch doctor to replace him or her.

4. Summarize the activity by telling students that one way we can find plants useful for medicine is from what we sometimes refer to as "witch doctors." Such medicines are often referred to as folk medicines. There are more than 3,000 plants used by tribal peoples throughout the world. Many of these medicines were used long before modern applications. Use two or three examples.

- Quinine was used by South American Indians as a cure for malaria. The Spaniards used it in the 1600s. U.S. troops used it in the second world war and Viet Nam. It is also used today to help regulate heartbeat.
- Mayapple (American mandrake) was used by the Penobscot Indians to treat cancer. Study of this plant led to the discovery of a useful anticancer drug from a related plant in India.
- Oil (cade oil) from prickly cedar has been used since ancient time to treat skin diseases. Today it is used in ointments, soaps and shampoos to treat skin disease. Finding useful plants through "witch doctors" is difficult, hence the game. Tribal cultures are remote. Witch doctors do not use regular names for plants so we often don't know which plants they are talking about. Furthermore, they often mix several different plants together and it is hard to pinpoint the active ingredient. However, it is one way to find plants potentially useful in medicine! After all, people from other cultures have done a lot of the hard work for us, screening plants for possible medical uses.

Activity 5. Nature's Public Services: Dust Mops

OBJECTIVE

Students will be able to describe economic benefits of plants, especially those that we take for granted.

MATERIALS

Plastic wash bottle
Plastic funnel
Filter paper/paper toweling
Water

PROCEDURE

BACKGROUND

Many plants, especially trees, clean up pollution. Trees clean the air of particle and gaseous pollution by serving as efficient filters for the air. The foliage intercepts dust in the air, hundreds of kilograms of it. Few people ever stop to think of the very real value of vegetation, the value that can be counted in dollars and cents. Vegetation, particularly trees, cuts pollution. This is one of the direct economic benefits of plants.

According to Norman Myers, "A one-hectare clump (2.5 acres) of beech or elm leaves can retain at least 40 metric tons (44 tons) of dust, sometimes much more. Along comes a shower of rain and washes the dust from the leaves into the soil, back where it came from. Not so effective, but still reasonably efficient are sycamore trees, able to take 25-30 metric tons (33 tons) of dirt per hectare from the air. Less effective still, because their needle-like leaves offer a smaller surface, are pine trees—yet they handle at least 15 metric tons (16.5 tons) of dust per hectare."

We often have a difficult time with the concept of how large an acre is. You can compare it to something youngsters can relate to. An acre is about the size of a football field from one five-yard line to the other five-yard line.

1. At an appropriate time explain to students that you have something in your backpack that will show one of the "way out" economic uses of plants. Have them gather close and when everyone can see, pull out the wash bottle with water, plastic funnel and filter paper or white paper toweling. Ask how these items might be used to show one of the economic uses of plants.

2. Have one of the students pour the water over some low-hanging leaves and into the funnel filter which is held by another student. Do not pick the leaves from the plants. Examine the filter paper and discuss this economic benefit: plants as pollution cleanup devices—a wild use of wild plants. Ask students whether trees/plants at home would be cleaner or dirtier than these and how they know.

SECTION III: CLASSROOM—POST-VISIT ACTIVITIES

Activity 6. Plants and Animals for Sale

OBJECTIVES

Students will be able to
1) explain our global dependence on wild plants; and
2) describe the effects of decisions they make on others.

MATERIALS

For the Class
1 Candy Bar

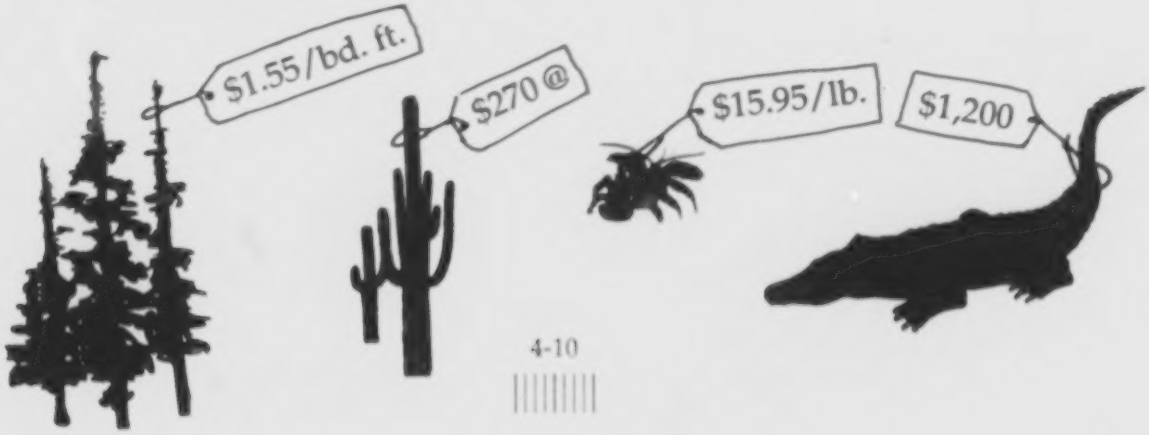
For Each Student
Blackline Master: WORLD CROP PLANT CENTERS

PROCEDURES

1. Distribute the WORLD CROP PLANT CENTERS blackline master to each student. Read the product information related to plants from a candy bar wrapper. Ask students to see if they can find the country each product comes from. Ask these kinds of questions: How many different countries? What natural product supplied the paper? Are there any animal products ? (The milk comes from cows whose ancestors were the aurochs which became extinct in Europe in 1627 A.D.)

2. Divide the class into teams of 4-6 each. Ask them to create a dessert, vegetable, or main dish recipe. They should list the ingredients and the countries they come from. Have each team use one map to color the countries that contributed to their recipe and then present their recipe and map to the class.

3. Ask these kinds of questions:
- Where are most of the crop centers located? (In or near the tropics.)
- How do we depend upon other countries for our food? What are some ways we are affected by disasters that happen to other countries?
- What are some effects we have on crop production around the world?



Activity 7. Farm Fields

OBJECTIVES

Students will be able to
1) describe the economic reasons to preserve biological diversity; and
2) recognize lessons we can learn from natural areas.

MATERIALS

None needed

PROCEDURE

1. Take a walk to a road side or natural area. Tell students that this is nature's farm field. It produces food for wild animals, birds, insects and other organisms. Ask students to list similarities and differences between this area and a farm field. Tell students that nature may have some tips to help us farm the land more economically.

For example, nature covers bare ground quickly with a large variety of plants. Many plants are soil builders, weed controllers (through shading and chemical means), and do not require animal fertilizers, but rather recycle them. Roots of plants bind the soil together, preventing soil erosion, and, because there are so many different kinds of plants, no one plant pest can take over and destroy the "crop." Plant parts on and in the ground keep temperatures warmer than on bare ground and increase soil moisture. The soil and plants act as filters, cleansing water from rainfall and snow. You may want to emphasize one of the biggest differences: most agriculture is based on annuals grown in separate fields (corn in one, alfalfa and soybeans in the next—or monoculture); nature is based on perennials and mixtures of plants growing together in one field—polyculture).

EVALUATION OF UNIT

1. Pick an item you had for breakfast or lunch. Trace the item from your table to where it came from. What wild plant or animal did it come from? What packaging materials did it come in? Where did it come from?

2. Pick your favorite meal. How many plants and animals does it depend on? How many different nations? Let youngsters have access to the blackline master, WORLD CROP PLANT CENTERS.

3. If you were going to tell someone why biological diversity was important, what would you tell him or her?
4. It has been said that the world is in a candy bar. What does that mean?

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CLASSROOM

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Ali Mitgutsch. *From Beet to Sugar, From Blossom to Honey, From Cacao Bean to Chocolate, From Cotton to Pants, From Cow to Shoe, From Fruit to Jam, From Grain to Bread, From Milk to Ice Cream, From Sheep to Scarf, From Tree to Table.* Carolrhoda Books, Inc.: Minneapolis, MN. (While these "start to finish" books are for primary children, they are still useful.)

GENERAL

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WORLD CROP PLANT CENTERS

THE VALUE OF CONSERVING WILD PLANTS & ANIMALS

LEARNING FROM WOODPECKERS

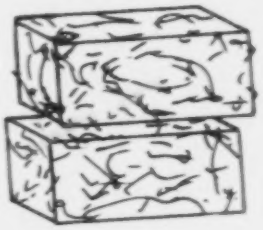
Designing better crash helmets. When a woodpecker is searching for insects or drilling a nesting place, it experiences large shocks to its head. It suffers no injury to its brain, neck or backbone. By studying woodpeckers scientists have found clues to improving crash helmets. Crash helmets should be made thicker yet lighter. The helmet should have a firm shock-absorbing foam held within thin layers of tough material. Helmets should also be designed to resist any sideways movement to avoid whiplash.

USES FOR FIREFLIES

Fireflies produce a flash from their tails when two chemicals react with oxygen—a substance found in all living things. This very efficient light uses little heat or energy. Scientists are experimenting with these insects in trying to create a cool, inexpensive, energy-efficient light.

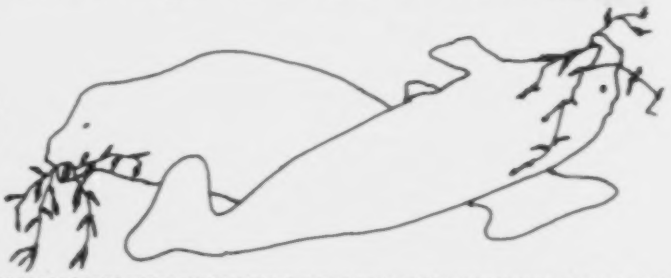
USING PLANTS TO BUILD HOUSES

The world needs millions of new homes. Mud-bricks are still used in most countries of Asia, Africa and Latin-America. Good bricks require strengthening materials. Some are expensive. A simple and cheap technology has been found. Elephant grass is chopped into small pieces and added to the brick material. The bricks do not need to be as thick as plain mud bricks. They are also five times stronger than mud bricks. The homes cost only a fraction as much as one using modern materials.



REMOVING WATERWEEDS

It is very expensive to use machinery to remove weeds from lakes and canals. Two animals that show some promise are insects and the endangered manatee. One of the insects is the South American flea beetle. It eats only alligator weed. This plant is not native to the United States. It was introduced and is now a major pest. Manatees eat large quantities of water weeds. They have been used in other countries to keep canals clean of water weeds.



THE VALUE OF CONSERVING WILD PLANTS AND ANIMALS WITH "GREEN GASOLINE"

There are many possibilities for producing gasoline and oil from plants. Corn is already being used to produce alcohol fuels (gasohol). A shrub known as the "gopher plant" shows promise for producing oil. The plant has a sticky sap like milkweed which repels gophers. It grows in the U.S., Europe, the Soviet Union, and Africa.

One scientist has asked, "How can we replace petroleum with *phytoleum?*" (petr = stone, oleum = oil; phyt = plant, oleum = oil).

A PLANT FOR A WHALE

Because of its oil and a hard wax that it carries in its head, the sperm whale has been hunted almost to extinction. While the whale is now protected it is still being hunted by some nations. The oil is a superior machine oil. The wax is a substitute for a costly wax from a Brazilian palm tree. Jojoba, a U.S. desert plant, produces oils and waxes that are equal to sperm oil and wax. The wax can be used in furniture, auto and shoe polishes, carbon and stencil paper, film coatings for fruits and vegetables. Jojoba is a multi-use plant. It is used in medicines and cosmetics. In 1983, jojoba oil was selling for $3,000 a barrel.

FIREWOOD

Most of the earth's people depend on firewood to cook their food and heat their homes. Firewood is very scarce in India, Africa, Central America, Nepal, Pakistan and parts of South America. Humans have already removed a large part of the earth's forests. This has resulted in soil erosion and in some parts of the world the amount of desert is increasing. A native of Central America, known as ipil-ipil—also called levcaena, lead tree or popinac in the U.S., koa haole in Hawaii, and bayani or giant ipil-ipil in the Philippines—is a fast growing tree. It grows four meters in height in six months. It provides firewood, food for cattle and wildlife, lumber, and poles for electricity and telephones. It protects and improves the soil and one day may even be eaten by humans, if varieties lower in poisons are developed.

Unit 5

BIODIVERSITY: CONSIDERING GLOBAL CONNECTIONS

OVERVIEW

Students learn how we depend on and affect the world's stock of plants and animals. They do this through original explorations, participatory games and creative dramatics.

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TEACHER BACKGROUND

The largest known ecosystem is the Earth. Ecologists refer to it as the biosphere. The central concept of the biosphere is that all life is interrelated. These interrellationships are particularly evident with large scale environmental problems such as air pollution. The idea of national boundaries quickly fades and we realize that we are in the biosphere together.

In 1987, 170,000 fires were counted in Brazil's part of the western Amazon. These fires were deliberately set by humans to clear virgin rainforest, mostly for agriculture. Such fires are estimated to contribute about one-tenth of the global production of carbon dioxide, the principal gas responsible for the warming of the earth's climate, known as the greenhouse effect, an issue of increasing concern.The ozone layer shields biospheric life from dangerous ultraviolet radiation. Chemicals which industrialized nations use daily for refrigeration, air conditioning, foam insulation, fire extinguishers, and aerosols are destroying that layer. The Antarctic ozone hole is the most striking example. In early 1989, atmospheric scientists reported that the Arctic ozone may be similarly threatened.

The imminent collapse of biospheric biological diversity is another problem of global dimensions. It is estimated that half the world's species may be lost within the next century due to human population growth and economic development. Although all nations are affected, most of the loss will occur in 13 countries. These so-called "megadiversity" countries account for more than 60 percent of the biosphere's diversity. They are Brazil, Columbia, Indonesia, China, Equador, India, Malaysia, Mexico, Peru, Venezuela, Zaire, Madagasgar and Australia.

Michael Robinson of the National Zoological Park, Washington, D.C., reminds us that the problems of preserving the biosphere's biodiversity is political and economic. "The problems are not due to ignorance and stupidity. The problems derive from the poverty of the poor and the greed of the rich." We in the U.S. provide few belt tightening models to these developing nations.

In 1987 more than 250 national parks or forests or newly designated reserve areas in 66 countries had been classified as International Biosphere Reserves, a program of the United Nations Educational, Scientific, and Cultural Organization (UNESCO). These areas are used to demonstrate how we can live with the biosphere without degrading it. National parks are part of the global effort to preserve the biosphere's biological diversity. There are more than 40 biosphere reserves in the United States. Seventeen of these are national parks. A motto useful in preserving biological diversity is to "think globally and act locally."

SECTION I: CLASSROOM—PRE-VISIT ACTIVITIES

Activity 1. Continents and Biomes

OBJECTIVE
Students will be able to locate the major biomes of the world on a map and briefly describe them.

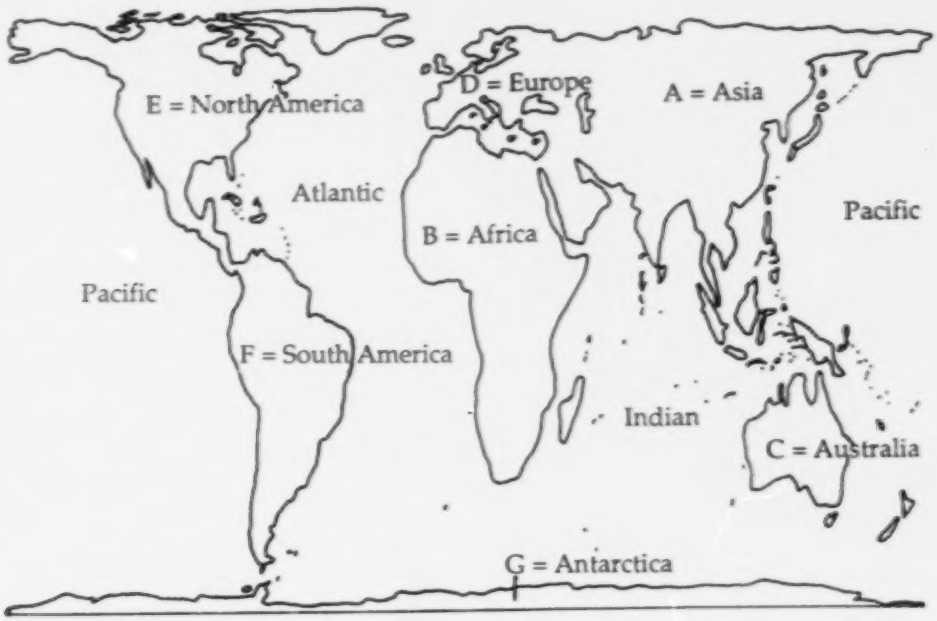
MATERIALS
For the Class
Overhead Projector
Blackline Master: BIOMES OF THE EARTH

For Each Team
Pencils
Crayons/Markers, Green
Blackline Master: WHAT DO WE ALREADY KNOW?

PROCEDURE
1. Make a copy of the blackline master, WHAT DO WE ALREADY KNOW?

2. Divide the class into teams of two and distribute a copy to each team. Emphasize that the purpose of this test is to see what is already known. Encourage students to answer the questions as accurately as they can.

3. Review the test.



What is a Biome? Which one do we live in? Place the transparency of BIOMES OF THE EARTH on the overhead and review the earth's biomes. Review the relationship between temperature and population and biome location on the earth. (Taiga biomes are also called boreal forests or conifer forests.) Have students point to places where it is cold all year long. Warm all year long. Where the climate (The average weather in one place over a long period of time.) changes throughout the year. What biomes are characteristic of these places?

Antarctica may have created some problems for students. It is dominated by ice although there are some small dry valleys. All but 2% of the continent is covered by ice. Kids may be interested to know that Antarctica is a desert but without the sand. And 150° F colder! Its total yearly precipitation is two inches, just a little more than the Sahara Desert. It has no native people and no wildlife live inland.

4. Summarize this overview by asking these kinds of questions:
- Which biomes have you visited? What do you remember about them? How are they different from our biome? What is our biome?
- The map of biomes suggests that biomes have sharp boundaries. Do they? How do you know? (Students who have traveled to another biome can help you with this. When you visit the park you can see how communities even within a biome, change gradually.)
- What kinds of people live in these biomes? How do they depend on nature?
- What words did you use to describe what is happening to biomes today? If you were to visit this biome when you are thirty, what do you expect it will be like?

EXTENSION

1. Hang a world map on the bulletin board. Have students bring their stuffed or inflatable plants and animals from home. Have them connect these to the appropriate map location with yarn. Label each animal with a tag telling its biome. Are all the continents and oceans represented? How many groups of animals? Are any endangered? Extinct? What is the most common? Uncommon? Are there any plants?

Activity 2. Building A Global Biodiversity Exhibit

OBJECTIVES

Students will be able to:
1) describe the characteristics of some of the earth's biomes; and
2) describe ways in which people, both locally and globally, depend upon the valuable resources of the earth's biomes.

MATERIALS

Art materials, e.g., crayons, paints, markers, scissors, glue, tape, poster board, newsprint, colored papers

PROCEDURE

BACKGROUND

In the Value of Conserving Genetic Resources, Dr. Margery Oldfield writes:

> "The public must be made more aware of the contributions of genetic materials and wild species to economic productivity and our society in general, as well as of the socioeconomic consequences of irretrievable losses of these renewable resources. The tangible economic values of many hidden genetic materials and obscure wild species are as difficult to perceive as are many of the economic goods and services they offer. Thus, most people do not have sufficient information to understand the impact that these national treasures can have on their daily lives. Exhibits should be provided in prominent public places, e.g., in the lobbies of government buildings, national, state and local museums and research institutions, USDA research facilities, and visitor centers of national and state parks."

There is no reason that students can't be among the first to do this useful and informational display for the school and the community.

1. Alert your librarian and ask for help in finding resources and pictures on the world's biomes, wildlife, and endangered plants and animals.

2. Divide the class into global biome biodiversity groups: desert, grassland, rain forest, temperate forest, taiga and tundra. Each continent should be represented. Add an Antarctica and an ocean group if you like. Help students limit the scope of the work. Groups are to create and design a display of their biome. The display should include:
- location;
- characteristics of the biome—plants, wildlife, temperature, rainfall;
- information on at least one endangered plant or animal (In the case of the rain forest, the entire biome is threatened.);
- conservation efforts; and
- the importance of wild plants and animals to humans—economic, medicine, food, industry.

The display can be a poster with text and pictures but it can also include models, real objects, such as dioramas and maps. Real objects might include products, collectors' items, or advertisements. Their significance should be explained.

3. Have a one-day open house to display the exhibits. Designers should stand nearby and be ready to explain and answer questions. If possible, see about having the open house in an area that is heavily used by people (a mall or the visitor center of the national park you visited). To help visitors with the exhibit you may also want to include:
- A map of the world's biomes.
- A list of some familiar products from the world's biomes. In addition also include real products, e.g., cocoa, coffee, tea.
- A background mural filled with newspaper/magazine headlines and stories about biomes, endangered organisms and efforts to save them worldwide.

4. Prior to the open house, have students prepare press releases for the local newspaper and radio station promoting the global biodiversity exhibition.

5. Leave displays up for about a week. Number each display/poster and leave a box with a slip of paper asking people to vote for their favorite display.

6. At the end of the week tally the votes and have the local media take a picture of the winning entry and its designers for publication in the paper or on television.

7. When you are finished discuss these questions with students:
- Of all of the biomes which is the most threatened? What is your evidence?
- Biomes are filled with special partnerships. What are some examples of plants and/or animals that depend on another plant or animal?
- What are the major problems affecting the world's biomes?

SECTION II. NATIONAL PARK—ON-SITE ACTIVITIES

Activity 3. It Is One World: The Gathering Circle[1]

OBJECTIVE

Students will be able to list and describe a variety of factors that demonstrate global interdependence and their significance.

MATERIALS

Rope, long enough to comfortably encircle an average sized class and enough left for you to pull on.
Anchor, tent peg
Optional: Hammer

PROCEDURE

1. Lay the rope in a circle on the ground and anchor one end. Make the circle large enough for the class to fit in comfortably. The rope represents environmental effects on the park.

2. Tell students to pretend that they are organisms in the park—its plants and animals. Help them assume these roles. "Plants" move their arms in appropriate positions/motions (perhaps swaying in the wind) and "animals" can move or make sounds like animals. Some "animals" may forage for food while others rest. If animals avoid, or try to avoid, each other, call attention to it.

3. Once the role playing is underway, tell students that, as you describe events, you will pull the rope. If the rope touches their feet they are to fall quietly out of the circle. Most endangerments/ extinctions are quiet and relatively unnoticed events. As the circle becomes smaller and smaller and space becomes more of a premium some organisms may simply get "squeezed" out. They, too, whether the rope touches their feet or not are to fall quietly out of the circle. No pushing. No shoving.

4. Read these kinds of events. Make this more site specific by including events that have affected your site, including such things as pollution events that affect habitat quality. Use appropriate pauses as you gradually diminish the circumference of the circle. This contributes to the drama. Environmental changes are slow. There is the feeling that nothing is really the matter and that one little problem can't make that much difference. The notes in parentheses are primarily for you. They are not to be read to the kids. You may want to use some of the information in your summary.
•The number of dry days has been increasing for several years. (Global climate change; deforestation)
• Migrating birds (name appropriate park species) fail to return from their winter homes in the tropics. (Habitat destruction)

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[1] Adapted from *Tropical Forests*, Global Tomorrow Coalition, Washington, D.C.

• Average daily temperatures climb. They are now several degrees (or 5° Fahrenheit) higher than they were 100 years ago. (Global climate change; deforestation)
• Pesticides used in other nations around the world drift into the atmosphere and during rain- and snowstorms and foggy days the organisms in the park are bathed in these poisons.
• The number of herds of cattle are increasing throughout the world. (Microbial activity in the digestive systems releases methane with subsequent T° increase.)
• Forests are being cleared for development, timber and firewood throughout the world. (Termites increase. Microbial activity in their digestive systems release methane with subsequent T° increase.)
• The number of acres of rice paddies is increasing. (Microbial activity in the rice paddies is a source of methane, T° increase results.)
• Chemicals released by industries throughout the world eat away at the ozone layer. (These materials—CFCs—are used as propellants in aerosol cans—hair sprays, in refrigerators, to dissolve materials and to produce plastic foam products. CFCs do not occur naturally; they are produced only industrially. The effects of increased ultraviolet radiation on plants and animals is not known. Some plants are very well adapted for high UV levels; others are much more sensitive. Single celled algae are very sensitive. If damaged their effects would lead to a decline in fish. CFCs are banned from aerosol cans in the United States, Canada, and Scandinavia. On September 15, 1987, 24 nations plus the European Community signed an ozone treaty in Montreal—the Montreal Protocol—to safeguard the ozone layer. Several other nations have signed the treaty since then. These nations will freeze and later reduce their production and consumption of CFCs.
• Increased use of agricultural fertilizers release gases into the atmosphere. (Some of them are in the form of nitrous oxide. Oxides of nitrogen react with other compounds to form smog which can damage plant and animal life directly and indirectly.)
• Acid rain, the by-product of human industrial activity, falls as rain and snow, and forms as dew. (Implicated in forest decline, lake death, the extinction of a species trout in Canada, aquatic effects such as changes in species composition and productivity.)

5. Summarize the activity and review some of the events. The events have two effects: the reduction of local biological diversity and impacts on biological diversity at distant locations. Then ask these kinds of questions:
• While these events affect biological diversity here what is happening to biological diversity where these events originate?
• Can you think of any other events that happen in one part of the world and affect a natural area in another? How would these events affect biological diversity here?
• What are some positive things we are doing to preserve animal and plant habitat areas?
• What are some things we do in our area that affect the populations of animals and plants in other areas?
• How do United States citizens affect plants and animals in other parts of the world?

Activity 4. Going Away for the Winter or What Do We Mean by "Our?"

OBJECTIVE

Students will be able to describe the effects of habitat loss in another part of the world on migrating birds.

MATERIALS

Lengths of rope, each one large enough to comfortably encircle the class
Tent pegs
Optional: Hammer

PROCEDURE

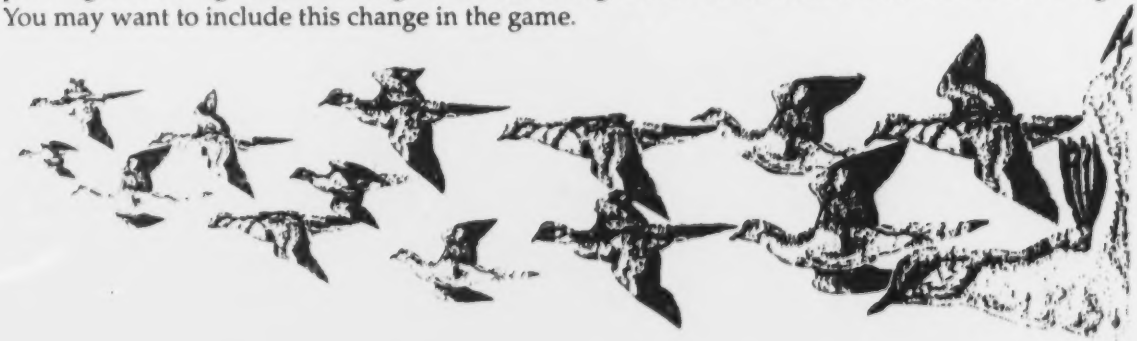
BACKGROUND

Protecting nesting areas may be only half the job for birds that winter in Central and South America. Wisconsin, for example, has a "watch list" of 32 bird species experiencing population decline or some other problem. Seven of these species must migrate to Central and South American rain forests for the winter and seven others migrate to other parts of South America. In Wisconsin many of what are referred to as "our" birds depend on jungles for their winter range. These include eastern wood pewees, veerys, parula warblers, and Canada warblers.

1. Select a large playing area about 50-75 feet in length. Make a circle from each length of rope at either end of the playing area. Each circle should have one end of the rope attached to a tent peg. One circle represents the summer home range while the other represents the winter home range.

2. These are the rules of the game. The "birds" start in the summer range in which they may freely "fly" about and make bird sounds. You call out months, when you call out the migrating month (pick one appropriate to your area), the birds must fly to the winter range. At the winter range, when you call out the migrating month (pick one), the birds must fly to their summer range.

After each round of migration make the winter range smaller. Students must be inside the winter range to survive; they must be able to range around freely and comfortably. Those that bump into one another or step on the rope are out and can stand at the sideline. Emphasize that there is no pushing or shoving. Summer range is also declining but at a much slower rate than winter range. You may want to include this change in the game.



3. You can carry the cycle of migration to its bitter end or stop at an appropriate point. Emphasize that many, perhaps all, of these birds are not endangered or threatened with extinction, yet. They are undergoing a population decline. Winter habitat for migrating birds is declining rapidly. (Each year an area about the size of Pennsylvania disappears from tropical rain forests.)

4. In discussion ask these kinds of questions:
- What is the difference between this kind of change and an out-break of a forest disease in an area of a tropical forest. (Emphasize short-and long-term effects.)
- Sometimes we refer to these birds as "ours." Whose are they?
- Is habitat loss pollution? Describe similarities and differences.
- These birds spend part of their lives in parts of the world that are not as developed as ours. People living there want a better way of life and one way they see to do this is by destroying forests. Can you think of any arguments that might be used to help them reconsider the destruction of tropical rain forests? Why might people in these countries resist some of our arguments on beauty or it's nice to have birds around? (Emphasize economic arguments on how plants and animals can "earn" money by promoting tourism, and providing medicines and foods.)

EXTENSION

1. Each second we lose an area of rainforest the size of 4/5 OF A FOOTBALL FIELD or 54 acres cleared per minute[2]. Have kids form a rectangle 80 yards long and 50 yards wide and to imagine that the area is a rain forest in the tropics. It will help if you have the area premarked at each of the corners. Tell them by the time they count 1,001, this area, once a forested tropical rain forest, has been cleared. Its gone, more than likely forever. It may be for agricultural land or timber or city development or a highway. The area may have been winter habitat for some of of our familiar birds. If so, they have been eliminated. There is not another place for them to move to or food for them to eat.

To represent the difference in area between 1 and 2 seconds have kids increase the area. One end of the line should move 80 yards in one direction, 1001, 1002, the tick of the habitat destruction clock. In a minute the area is equal to TEN CITY BLOCKS. GOING... GOING... GONE!

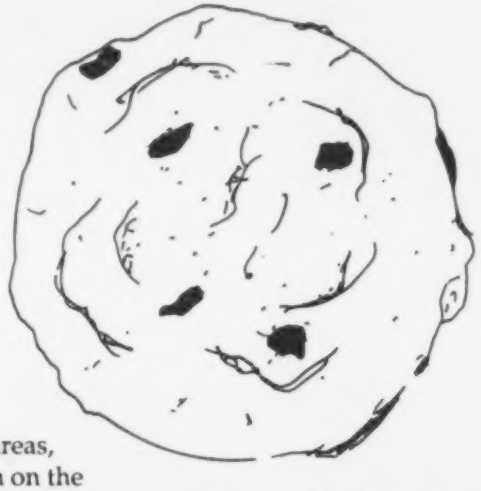
[2] Data on habitat loss for tropical rain forests are from Smithsonian Institution Traveling Exhibition Service.

SECTION III. CLASSROOM—POST-VISIT ACTIVITIES

Activity 5. Meals for the World: What About the Critters[3]

OBJECTIVE

Students will be able to experience and describe the effects of the unequal distribution of the world's resources on humans and on biological diversity.



MATERIALS

Masking tape
1 population card per student
88 cookies
Serving tray
1 Napkin or paper towel/Continent
World map/Globe
Blackline Master:
PLANET DATA AND FLOOR PLAN CHARTS
Optional: M&M's, fruit, vegetables

PROCEDURE

1. Use masking tape to divide the room in six unequal areas, preferably before students come to class. Use the design on the blackline master, PLANET DATA AND FLOOR PLAN CHART[4]. (In the data provided, Greenland and Australia are not included.)

2. When students enter the room each one should pick a slip of paper from a hat or bowl indicating the name of their continent/land area. This emphasizes the element of chance on where one is born in the world. Students are to go to that area of the room and wait for the lesson to begin. Students are to stay within the boundaries although they may talk with one another.

3. Tell students that the number of students assigned to each continent/land area represents its population. The area assigned roughly represents the amount of land. Ask students to describe and discuss with them how people live in each continent.

4. Uncover the serving tray with its 88 cookies (or M&Ms, fruit/vegetable sticks). Distribute the gross world product (tray of cookies) according to the share provided. Remind students that this is food and wealth. The wealth represents the ability of people in these areas to purchase or produce food.

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[3] Adapted from *ENDING HUNGER: Curriculum and Resource Guide,* The Minnesota Ending Hunger Project.

[4] Ibid. Smithsonian Institution Traveling Exhibition.

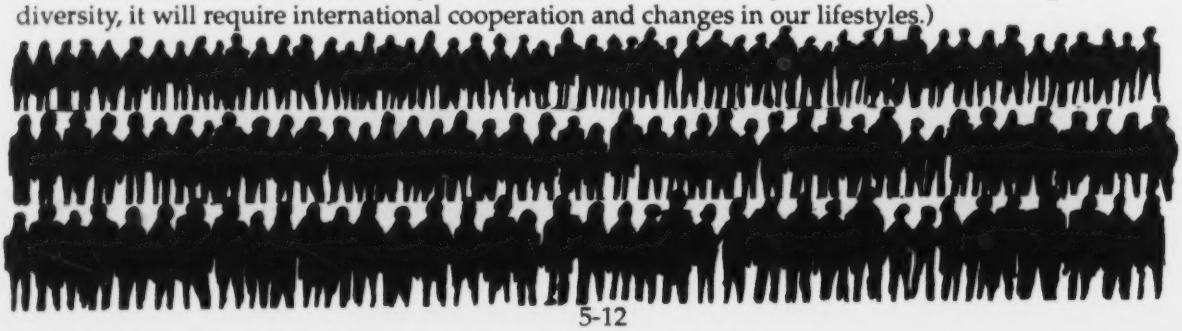
5. Allow students to do what they want for 10-15 minutes with minimal intervention. You may have to remind them to stay within their boundaries. There may be threats and other exchanges as well as promises to save and share the food later. This is forbidden. You may want to write student comments down and use them in discussion.

6. Announce that the activity is over. Discuss this experience with the students using these kinds of questions:

- Describe your experience. What were your reactions? How did you feel as you looked around the room?
- Did any of you ask for food?
- What did it feel like to be crowded?
- What did you want to do with your food? Share, hide, trade it? Did you want to walk to another continent and share it?
- Did you think about how you would survive? What you would do?
- How is food prepared in each of the continents? Point out that in many of the less developed countries fuel for heating and cooking is leading to deforestation. In many areas of Africa and Asia (point these out on a map), collecting firewood is an enormous task. It often takes villagers in Nepal and the dry areas of Africa eight hours to walk to sources of wood, gather enough wood for a day or two, and return home. In Africa areas harvested for wood become scrubby trees and grassland. Then, the scrubby trees are cut for firewood and cattle eat the grass. This soon turns into desert.

The number of humans living on the planet grows and grows and grows. The human population of the earth is more than five billion. Humans must have food, water and space in which to live and raise families. The loss of living space is not the only threat to the world's plants and animals. They are also collected and illegally killed for their skins, meat, tusks or horns.

- Which countries are most crowded? What choices do they have?
- What choices are available to nations who do not have enough money to buy food from other nations? (Remind students that many nations are encouraging their poor to move into wilderness tropical forests as pioneers and farmers. Land is cleared and it produces for a few years. However, the land begins to blow, wash away and change. It is difficult to believe that something as rich as a jungle with so much life can become land almost as hard as concrete in only a few years.)
- What is missing from this game that would make it more life-like? (Animals, plants, information about areas where people live, how much land is available for agriculture.)
- What are some important ideas involved in this game? (Unequal distribution of global wealth; interrelatedness of all life, human, plant/animal; and if we are to protect the Earth's biological diversity, it will require international cooperation and changes in our lifestyles.)



Activity 6. Jungle "Hamburgerization"

OBJECTIVE
Students will be able to describe the real costs of a hamburger in terms directly related to biological diversity.

MATERIALS
Masking tape
Yardstick
Art materials, e.g., markers/crayons, poster board, scissors, glue, craft paper, paints, construction paper

PROCEDURE
BACKGROUND
Much of Central America has been deforested over the past 25 years to form cattle pastures. According to Dr. Christopher Uhl, Pennsylvania State University, and Dr. Geoffrey Park, New York Botanical Gardens, a typical four-ounce hamburger represents about 55 square feet of tropical forest.

Each hamburger is equal to about a half ton of forest. Emphasize impacts of the "hamburgerization" of the jungle. These instant cow pastures have a lifetime of about eight years. After a few seasons, the jungle turns into a scraggly piece of very hard ground, similar to the floor. The cattle growers then move on and cut more rain forest. The profits, large and short-term, do not benefit the poor farmers. It is wealthy ranchers and large, multi-national corporations that receive the benefits. The average farmer eats less beef per year than the average American house cat. Because of the damage to the land, farmers are left in even poorer and more difficult farming conditions.

Tropical forests are sources of timber, a great variety of raw materials, and new food and new drug plants. Used for these purposes and with good sense, the forests have a chance of lasting almost forever; used for hamburgers, they are probably gone forever.

1. Mark off 50 square feet of your classroom and have students make a display for it. This could be a mural, posters or a model of a forest patch. Have students do some research so that they can capture the biological diversity—all its colors and forms. The space would contain the following:

Kinds of Organisms	*#*	*Height in ft*	*Weight in lbs*	*Notes*
Tree	1	60	875	
Saplings, seedlings	50		120	20-30 of the 50 are different kinds, some rare
Insects	1000s		2	100 different kinds (species); many not known to science

In addition, dozens of birds, reptiles and mammals would pass through and use this forest patch. Scientists represent their contribution at two pounds. (Most of it probably feces, recycled in the ecosystem.) In addition there would be an "unimaginable abundance" of mosses, fungi and organisms that can be seen only with a microscope. Altogether they might weigh about one pound. Represent this patch with a single hamburger.

2. Use these kinds of questions to summarize the work.
• The total beef from a steer can be ground to about 800, four-ounce hamburgers. One steer requires 43,793 square feet. Is this larger/smaller than the school, the school plus the playground or...?
• What are some ways we could lessen our impacts on tropical forests? Are any of these things you are willing to do? What might be some consequences of your actions?
• Would you be in favor of labeling all imported meat? What do you see as its major strengths and weaknesses?

EVALUATION

1. Describe three differences between tropical forest land that is used to pasture cattle and tropical forest land that is never used for cattle pastures.

2. What are two differences in food chains from an undisturbed tropical forest and a forest used to raise cattle for hamburger?

3. Suppose someone says to you that compared to many other problems, we should not worry about destroying a few acres of jungle for cattle pastures. There is a lot of jungle and besides it is a long way from here. Write a story to convince the person to change her or his mind.

RESOURCES

CHILDREN

Judy Cutchinsand and Ginny Johnston. 1986. *The Crocodile and the Crane: Surviving in a Crowded World*. William Morrow and Company.

Gill Gould (Compiler). 1980. *Animals in Danger*. (Five books on mammals in Asia, Africa, Europe, North American and the oceans). The Roarke Corporation, Inc.

Robert Prosser. 1987. *Disappearing Rainforest*. Dryad Press Limited, London.

John Norris Wood and Kevin Dean. 1987. *Nature Hide and Seek: Jungles*. Methuen, London.

CLASSROOM

Mary Adrian. 1978. *Wildlife in the Antarctic*. Julian Messner, New York, NY.

Biosphere Reserves. Full color brochure on biosphere reserves. Free, while supplies last. U.S. Man and the Biosphere Program, OES/ENR/MAB Department of State, Washington, D.C. 20520.

Janet and Alex D'Amato. 1971. *African Animals Through African Eyes*. Julian Messner, New York, NY.

Nancy Field and Sally Machlis. Learning and activity books on marine animals, salmon, endangered species. Dog-Eared Publications, P.O. Box 863, Middleton, WI 53562.

NatureScope. National Wildlife Federation, 1412 Sixteenth Street, N.W., Washington, DC 20036. (A large collection of teaching booklets focusing on the natural world.)

Smithsonian Institution. 1988. *Going...Going...Gone? Tropical Rainforests—How They Work, What They Do For Us, What's Being Done To Them.... Art to Zoo*. Smithsonian Institution, Office of Elementary and Secondary Education, Washington, D.C. 20560.

Yanamamo. Boosey and Hawkes, Inc., Promotion Department, 24 West 57th Street, New York, NY 10019. (A musical about rainforests by children at St. Augustine's School, Billington, Blackburn, England.)

GENERAL

Norman Myers. 1979. *The Sinking Ark: A New Look at the Problem of Disappearing Species*. Pergaman Press, New York, NY.

Norman Myers (ed.). 1984. *Gaia: An Atlas of Planet Management*. Anchor/Doubleday, Garden City, NY.

Howard F. Robinson. 1986. *Wonders of the Jungle*. National Wildlife Federation, Washington, D.C.

Joseph K. Skinner. 1985. *Big Mac and the Tropical Forests*. Monthly Review 37:25.

Tropical Rainforests: A Disappearing Treasure. Smithsonian Institution Traveling Exhibition, Office of Public Affairs, Smithsonian Institution, Washington, D.C. (Starting in 1988 and during the next five years this exhibit will show in Portland, Charlotte, Indianapolis, Los Angeles, St. Louis, Boston, New York City, Denver, New Orleans, Houston, Atlanta, Chicago, St. Paul, and Toronto. The exhibit includes a life size model of a fig tree, a multimedia slide show, a U.S. living room filled with rainforest products, and an interactive video that involves participants in management decisions.)

Christopher Uhl and Geoffrey Parker. 1986. *Our Steak in the Jungle*. BioScience 36(10):642. U.S. Government Printing Office. An excellent source of posters and publications on plants and animals, endangered species. For a list of items write Superintendent of Documents, U.S. Government Printing Office, Washington, DC 20402.

WHAT DO WE ALREADY KNOW?

NAMES _____

1. Name the Continents.

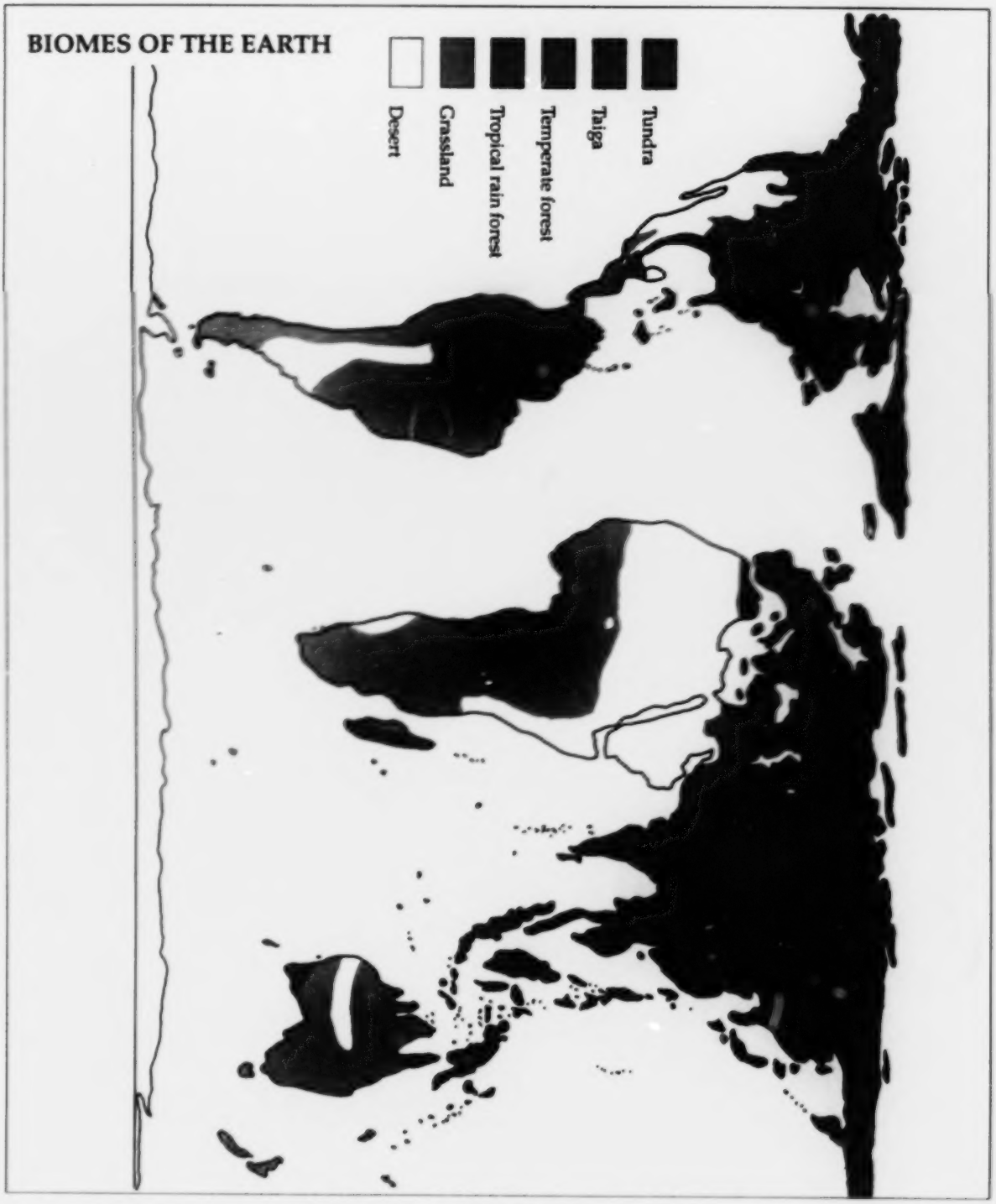
A _____
B _____
C _____
D _____
E _____
F _____
G _____

2. On the map write the names of the oceans. There are three of them.

3. On the back, choose the biomes you selected and locate it on a continent. Describe the people who live there and how they depend on nature. Write some words that describe what is happening to this biome today.

4. A biome is a large region of the earth. It has similar temperature, rainfall and kinds of organisms. The earth is divided into six major biomes. They are briefly described below. Draw where three of them are located. Make a key. One must be rain forest. Use green for the rain forest and ▥ and ▩ for the other two.

TUNDRA
Treeless, cold, dry, mosses, low shrubs, caribou, foxes, wolves.
TAIGA
Long winters, short summers, mosses, lichens, trees that produce cones, moose.
TEMPERATE FORESTS
Cold winters, warm summers, trees lose leaves in winter, deer, squirrels, insects, hawks, owls.
RAIN FORESTS
Heavy rain, strong sunlight, warm, many more animals, plants, and insects than we know exist.
DESERTS
High temperatures, very little rain, cactus, shrubs, rats, insects, reptiles, vultures.
GRASSLANDS
Cold nights, warm days, grasses and more grasses, hoofed animals, insects.


BIOMES OF THE EARTH
Tundra
Taiga
Temperate forest
Tropical rain forest
Grassland
Desert

5-18

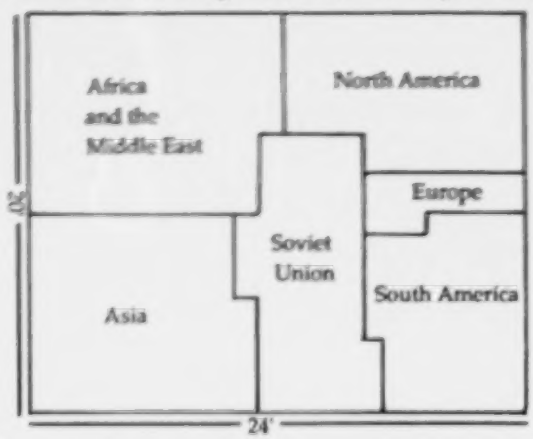
PLANET DATA AND FLOOR PLAN CHART

CONTINENT/LAND AREAS	POPULATION 1975*	GROSS NATIONAL PRODUCT**
Africa/Middle East	3 (3)	2
Asia	24 (18)	12
Europe	5 (4)	33
North America	2 (1)	26
South America	3 (2)	3
Soviet Union	3 (2)	
TOTALS	40 (30)	88

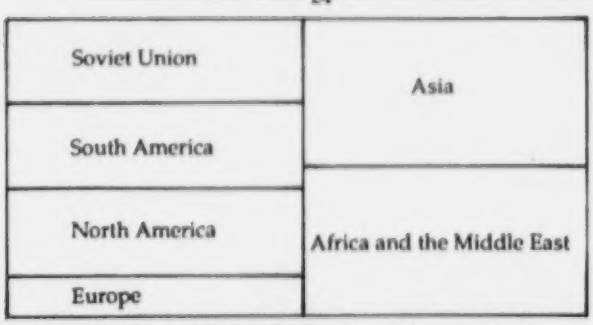
* Population. For classroom of 40 and 30, in parentheses.

** Gross National Product. The value of all of the goods and services provided in a single year. Division of 88 cookies.

CLASSROOM DESIGN



REPRESENTATIVE



Notes: Divide half of the room into Africa/Middle East and Asia. In the remaining half make Europe about wide. Divide the remainder of the space more-or-less evenly between the other continents: Soviet Union, South America and North America.

Unit 6

HABITAT AND NICHE

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OVERVIEW

Through investigations of commonly found organisms and games in the classroom and field, students learn about the importance of habitat and niche in preserving biological diversity.

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TEACHER BACKGROUND

Five hundred years after Columbus came to the New World, America's plants and animals are seriously depleted. More than 140 kinds of animals and approximately 60 kinds of plants have been declared extinct. Another 204 kinds of plants are probably extinct. The U.S. Fish and Wildlife Service (FWS) has listed 464 kinds of plants and animals as threatened or endangered; 3,800 additional kinds of plants and animals are in such danger that FWS has designated them as "candidates" for listing as endangered or threatened.

The leading cause of these extinctions has been habitat alteration by humans for purposes of converting land to more immediately recognized, productive uses. Habitat alteration by humans is also responsible for endangering plants and animals.

Encroaching on habitat has been the principal cause of the decline of a number of different kinds of organisms. In the southwestern United States logging operations threaten the Venus fly trap. The Houston toad is endangered by loss of habitat from urban-industrial expansion. Attwater's prairie chicken is in trouble because of overgrazing and cultivation of its prairie habitat.

It is difficult to understand the full meaning of the term habitat alteration without having a good understanding of the terms "habitat" and "niche."

Habitat is the place where an organism lives; its home address. It is the organism's physical living place. The niche is a plant's or an animal's profession, occupation or job—its role in life. The niche of an organism is about relationships, the relationship to the place where it lives as well as to other organisms living there.

The profession or niche of an organism has a great deal to say about where the organism lives. The niche of the earthworm includes feeding on decaying plant and animal parts in the soil. However, there are many things that have to be right for the earthworm to occupy that niche: climate, soil conditions, natural enemies. But the niche is about more than food. It is everything the organism must do to survive and to leave its young.

Another perspective on niche is provided by the work of Robert MacArthur. He studied five different kinds of warblers which live in the spruce forests of Maine and Vermont. The five birds eat roughly the same kind of food, spruce budworms. MacArthur's painstakingly careful research showed that the five warblers find their food at different places in spruce trees. One habitat; five different niches. Each bird had different behaviors and hunting methods, allowing it to survive and leave babies.

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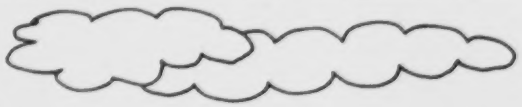
SECTION I. CLASSROOM—PRE-VISIT ACTIVITIES

Activity 1. A Critter's Place

OBJECTIVES

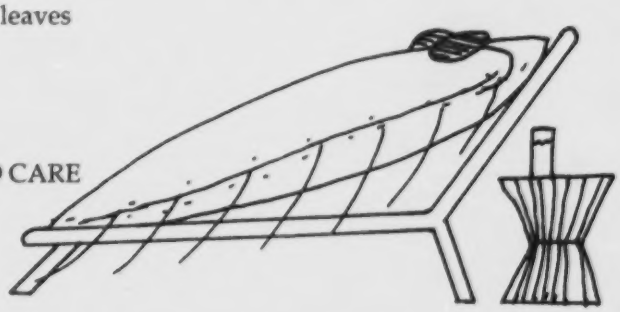
Students will be able to
1) describe the structure and behavior of a relatively simple organism;
2) be able to construct an appropriate cage based on characteristics of the animal's environment; and
3) show concern for living organisms.



MATERIALS

For the Class

2 buckets, one for soil, the other for moist, decaying leaves
Paper toweling
Tacks, small nails
Water
Newspaper/toweling for work surface
Blackline Master: ISOPODS - BACKGROUND AND CARE
Optional: plant mister



For Each Team

Plastic spoon
Hand lens
Small containers—one-half pint milk cartons that have been rinsed or small cottage cheese/margarine containers
1 plastic meat tray for a pen (optional)

PROCEDURE

1. If you are not familiar with isopods read the blackline, master, ISOPODS - BACKGROUND AND CARE.

2. Tell students that they are going outside to collect isopods. Find out whether they know what isopods look like and where to find them. If they don't, describe isopods, show/make drawings or display a real isopod, and describe their living requirements. Do not distinguish between the two different kinds of isopods. Ask children to predict where they will be found in the schoolyard. Divide the class into teams of two. Give each team a plastic spoon, hand lens and a small container with damp paper toweling in it. Each team should collect five to ten isopods. Help each team collect both kinds of isopods. Emphasize that isopods are soft and can be hurt very easily. Students are to collect them with spoons. (Isopods can be picked up by hand but because they are soft, it is easy to hurt or crush them. Have students use the spoons to place them in their hands. Pillbugs will roll into a ball; sowbugs will continue to run.)

3. After students have collected their isopods they should observe them for at least ten minutes. Have students place a piece of moist paper toweling in a tray/container lid. The toweling should be a little smaller than the surface. Now add the isopods. Students can also add a small piece of toweling (wet or dry; flat or crumpled up). Isopods can be touched with pencils/finger. Remind students to be careful. Children should make sketches and take notes on what they observe.

4. Now have students make cages for their organisms. Have them place a moist paper/leaf layer on the bottom of the container, cover it with loose soil and place moist, decaying leaves on the soil surface. Then have them place the sowbugs in the cage, if necessary punch holes in the top of the container and cover their cages.

5. Debrief the work by asking these kinds of questions:
- What color are these organisms?
- What is the shape of these organisms?
- How do isopods protect themselves?
- Can these organisms walk on smooth surfaces?
- How many legs do they have? How can you tell the front from the back?
- Are all the isopods the same or are there different kinds of isopods?
- Describe their behavior, i.e., what do isopods do?
- Is each isopod different, i.e., can you tell them apart the way I can tell each of you apart?
- Describe this animal's home.
- How do isopods get their food, water, shelter?
- Would this animal be affected by drought? How?
- What might affect this animal's home?
- Should we do what we can do to protect isopods? Why? How can we protect them?
- Should living things that we don't hunt, eat, or use in any way be protected?

6. Have students write and illustrate a short report about isopods.

7. Save the isopods for use in pre-visit Activity 2 and/or 3. If you do not intend to do these activities release the isopods using the procedure described on page 8.

Activity 2. The Address of Home Sweet Home

OBJECTIVES

Students will be able to
1) conduct an experiment to determine environmental preferences;
2) describe environmental preferences of isopods; and
3) define habitat

MATERIALS

For the Class
Waxed paper/plastic wrap
Cloth
Sand/soil/sawdust; wet and dry
Leaves, dry and moist
Jar lids
Paper toweling/newspaper
Transparent tape
Potato slices
Newspaper/toweling for work surfaces
Blackline Master: ISOPOD ENVIRONMENT PREFERENCES

For Each Team of Four
Food tray/shirt box
Scissors
Spoons
Isopods and the containers in which they were stored from Activity 1.

PROCEDURE

1. This is a good activity for near the end of the day. The results can be investigated the first thing the following morning. Present students with the challenge: WHAT ENVIRONMENTS DO ISOPODS PREFER?

2. Place students in teams of four. Describe the materials you have available for them to use. Have each team construct at least four isopod environments. These small environments are to be separated from each other and placed on a tray or box. To prevent the isopods from escaping cover the bottom and sides of the container with wax paper.

3. After the environments have been constructed, students should pool their isopods and place the fifteen to twenty that they have between them in the tray.

4. Give each student a copy of ISOPOD ENVIRONMENT PREFERENCES and have them fill in Parts I, II and III. Encourage students to work together as they fill in their data sheets. Encourage them to use labeled diagrams, too.

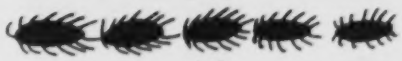
5. When students arrive in the morning, have them complete their data sheets.

6. Carefully return the isopods to their cages.

7. Help students summarize their work by discussing these kinds of questions:
• Do isopods prefer some places more than others?
• What are the characteristics of places they like best? Like least?
• Did any team use the same kind of environment in which the isopods are caged? If so, was this preferred above all the others?

8. Tell students that the science word used to describe the place where a population of organisms is found is its HABITAT. Habitats provide an organism's needs. These include food, shelter, water, space to mate, raise young, grow and suitable living conditions—temperature, light conditions, humidity, soil, vegetation. Write it on the chalkboard.
• How are the habitats in the experiment alike and different from the natural habitat? In the cages where the isopods are kept?
• Tell students that scientists refer to habitat as the address where an organism lives.
• How is it like an address?
• How would you describe your "address" (habitat)? Is it different from an adult's? How? A family pet? How? A bird living in your neighborhood? How? Is a plant's habitat more or less like an animal's habitat? How do you know?

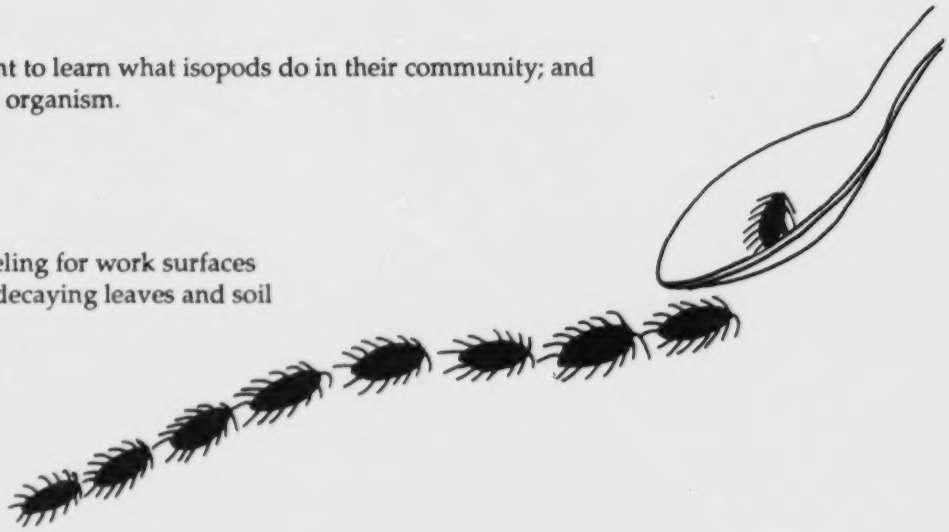
9. Tell students that some parts of an organism's habitat are more important than other parts of its habitat. This is essential to the survival of the organism. This is known as CRITICAL HABITAT. Write it on the board.
• What might be some critical habitat requirements for isopods? (moist places to live; decaying leaves)
• What might happen to isopods if this essential part of their habitat were destroyed? (local extinction would occur) What are some ways this could happen? (Remove all the trees, construct a playground, parking lot)
• Has any isopod habitat been destroyed?
• Why aren't isopods likely to become extinct even if the place we collected them were changed? (They live in a variety of places; occupy diverse small habitats.)
• Can you think of other organisms that are likely to survive habitat changes? (Dandelions occupy a variety of habitats from full sun to shade; house sparrows build nests and raise their young in a great variety of places.)
• Can you think of any organisms that are not likely to survive habitat changes? (see school site example below)
• Place the list of habitat needs in a column on the board: food, shelter, water, space to mate, raise young, grow, temperature, humidity, sunlight, soil, vegetation. What organisms might be affected if a temperature and humidity controlled dome were built over the school and its outdoor area? If all the trees were removed? Could these organisms survive?
• If you know the names of some organisms that were once common to the habitat on which the school is located, use them to illustrate the consequences of habitat changes. What are some reasons these organisms disappeared?



Activity 3. The Profession of ISOPODING

OBJECTIVES

Students will be able to
1) conduct an experiment to learn what isopods do in their community; and
2) define the niche of an organism.



MATERIALS

For the Class
Water
Newspaper/paper toweling for work surfaces
2 Containers for moist, decaying leaves and soil
Plant mister

For Each Team of Four
2 Cages with covers
3 Spoons
Isopods from Activity 1

PROCEDURE

1. Present students with this challenge: JUST WHAT IS THE JOB OF ISOPODS IN THEIR COMMUNITY?

2. Place students in teams of four. Describe the materials you have available for them (all of their isopods, 2 cages with covers, a few moist decaying leaves, soil). Ask them how they could use these to find out what the job of being an isopod is?

Students should first clean and rinse two of the plastic containers. They then place a few moist leaves in both with all of their isopods and cover it. Check to be sure that the container's contents are kept moist—not wet. Show them where the plant mister is and, if necessary, how to use it. The leaves should be damp not soaking wet.

3. Have students make daily observations for three to five days. These should take about ten minutes/day. What are the organisms doing? Where are they? Are there any changes? If so, what has changed?

4. Help students summarize the work by discussing these kinds of questions:
• What are your observations?
• What are your conclusions or interpretations?
• If an isopod were to ask, "You have been watching and studying me for a few days. What is my job?" what would you answer? (Students might say: dead leaf eater; assist in soil making; decomposer)
• What are some other jobs isopods might do? (This is more inferential in quality than the other questions. They reproduce and make other isopods; serve as food for other organisms; break food (leaves) into smaller chunks so that other organisms can use them, e.g., fungi. Is there any evidence of these?)
• What are some other organisms found in an isopod's community? (Students are likely to mention ants, spiders, earthworms, birds, plants.)

5. Tell students that the science word used to describe the jobs an organism does in its community is NICHE. Write it on the chalkboard.
• Tell students that scientists refer to the niche of an organism as its profession. How would you describe the profession of isopoding? (The niche of an organism is more than what it eats but this is quite a complex idea.)
• What is your profession, your niche at home? How is it different from your habitat? Does your niche change at school? Your habitat? How does your niche differ from that of an adult with whom you live? How is it similar?
• What are some ways we might learn what organisms eat isopods? What are some guesses you might make? How do you know? (Students should refer to organisms likely to be found in the isopod community, e.g., ants, spiders, birds, mice, shrews.)
• What do you think would happen to this community if the isopods were removed? What do you think would happen in our human communities if there were no garbage collectors?

6. Return the isopods to their environment. This is an important part of this activity and is worth discussing and planning. Where will the isopods be returned? One of the emphases in this investigation has been on habitat place. Returning the isopods to the environment provides a real opportunity to review the concept. The decision is similar too, to the kinds of decisions that park managers and park scientists face when they reintroduce organisms to the world. Should they all be put in the same place or should they be scattered around the school yard environment? What are the characteristics of an ideal isopod habitat and where is it?

SECTION II. NATIONAL PARK—ON-SITE ACTIVITIES

Activity 4. The Incredible Shrinking Habitat[1]

OBJECTIVES

Students will be able to
1) describe the consequences of shrinking habitat;
2) understand and describe the role of parks in preserving biodiversity; and
3) understand the role that all humans have to play in preserving biodiversity (Letting Joe or Jane do it is not enough).

MATERIALS

For Class of 25
5 Frisbees
20 Popsicle sticks
25 Name tags
Rope/String

PROCEDURE

1. Round 1. Place rope in a large circle and have students stand just outside of it. Tell them they can choose to be any plant or animal they would like to be. Have them make a name tag so that the others will know what plant or animal they are.

Place the frisbees inside the circle. Distribute 20 popsicle sticks among the five frisbees. Have students walk or trot slowly around the perimeter of the rope circle. When you yell out "Home Address" students rush to get a popsicle stick. There is a rule: No pushing or shoving. Those who do not get a stick stand outside the circle.

2. Round 2 and Round 3. Collect the popsicle sticks, reduce them by five, and redistribute them.
• Do you have any ideas what the various rounds and frisbees represented? Round 1, before Columbus and settlement of the U.S. by Europeans. Rounds 2/3. Changes in habitat by Europeans, e.g., for agriculture, wood, cities. Frisbees = habitat. Diminishing number of frisbees = decreasing amount of habitat available for plants and animals. Elimination of species by bumping = interference by humans that decreases the amount of habitat available.

Organisms eliminated may be either endangered or have become extinct. The remaining frisbee(s) represents a national park. They provide habitat protection and for many species provide critical habitat. Reinforce this concept and use a local example, if possible. Ask:
• What are some ways humans "bump" into plants and animals and cause them to become endangered?
• What are your views on what should be done about this?

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[1] Based on "Islands." *The New Games Book*, Doubleday and Company.

Activity 5. Scenery Seen

OBJECTIVES

Students will be able to
1) describe the characteristics of particular habitats;
2) compare differences between habitats; and
3) define critical habitat.

PROCEDURE

1. During the interpretive walk through various habitats, stop and have students describe the habitat they are in. Take only a few moments and then gather students together to share what they have observed. Students have had a learning experience with the microhabitats of isopods. During the sharing and your discussion of the habitat, describe and point out microhabitats. Point out the examples in your park of critical habitat for endangered wildlife and plants. It may be something as "simple" as space; it may be a suite of specific requirements provided only by the park.

2. Use these kinds of questions:
- What do we mean by habitat?
- What are the characteristics of this habitat?
- Have you ever seen this kind of habitat outside the park?
- How is it similar to the habitat we just walked through? Different from that habitat?
- What dangers do organisms face in this habitat?
- How does this habitat meet the needs of organisms?
- What is a descriptive name for this kind of habitat?
- Could this habitat ever change? How? What are your ideas about what would happen then?

Activity 6. Space For A Niche

OBJECTIVES

Students will be able to
1) describe the niche of a park species;
2) identify a critical feature of that organism's niche; and
3) cite threats to biological diversity and ways preservation of biological diversity can be promoted.

MATERIALS

Cards, 3" x 5", class set
Blackline Masters:
NICHE OF A BALD EAGLE
SOME BALD EAGLE NICHE DIMENSIONS

PROCEDURE

1. Niche has been defined as all interrelationships of an organism with its environment. Fairly large lists follow from such a definition! They suggest a complexity of relationships that few of us even begin to appreciate or understand. Develop a set of cards which describes the niche of an organism, endangered, if possible, and/or one for which the park provides critical habitat. There should be one niche characteristic per card. One of the cards should have name of the organism. This card is for you or for one of the students. Some of the niche dimensions of a representative species, the bald eagle in northern habitats, have been provided as an example which you may choose to use. (Blackline Masters: NICHE OF A BALD EAGLE and SOME BALD EAGLE NICHE DIMENSIONS provide some background.) The niche dimensions emphasize nesting habitat. Fall and winter habitat are important, too. Add these details if you can.

2. Gather students around you. Tell them that you have in your backpack the niche of an organism.

3. Have students quickly take a card from your backpack and form a circle, shoulder-to-shoulder. Tell students this is your niche. Have them quickly read their card aloud and as they finish, you squeeze into the circle and ask them to guess who you are.

4. Ask, "What might happen if... (e.g., the food of eagles is polluted by chemicals or if the eagles were disturbed by logging operations.) The card holder(s) can either step away from the circle or collapse to the ground. A gap is left. Children may think that this gap can be hurdled or breached somehow, after all, it appears quite small. This isn't the point. It's either gone or damaged...the right combination of things has been changed and the organism is in trouble. In the case of the eagle you can recount the history of the bald eagle and the role of parks in its recovery. The student playing the part of critical feature can fill the gap and make the circle whole, emphasizing the role of the park in the preservation of biological diversity.

5. Ask students to give you some examples of threats to biological diversity. Then ask them to list some ways in which they can contribute to preserving biological diversity.

SECTION III. CLASSROOM—POST-VISIT ACTIVITIES

Activity 7. Habitat Chairs

OBJECTIVES

Students will be able to
1) describe an organism and its habitat;
2) examine the relationship between land use choices and their consequences for other organisms; and
3) describe how plants and animals depend on humans.

MATERIALS

For the Class
Record/tape: "This Land Is Your Land" or "Home on the Range"
Record/tape player
Tape

PROCEDURE

1. Have students prepare a short description of a wild organism and its habitat. It should also contain an illustration of the organism in its habitat.

2. Place chairs in a row (one less chair than there are students), alternately facing left and right. Students tape their description to the back of a chair. When the music starts indicate the direction that they are to start walking around the chairs. When the music stops they must find a seat. Remove a chair after each round. You can play the game until it ends...with one species the winner! You will want to emphasize that they play fair. No pushing, shoving, and above all, no one hurt. Your chairs may be fixed to desks. If so, place the student descriptions in a circle on the floor. Students walk around inside the circle until the music stops. At that point, they scramble to find a description and stand in front of it. Remove a description after each round.

3. Summarize this part of the lesson with a discussion.
- How much biological diversity did we begin with? (Kids can count the number of different kinds of organisms. You may want to classify them. How many different groups? Were there any insects? Snakes?)
- When habitat is disturbed what are some consequences for the organisms? (Be sure to emphasize that if enough habitat is destroyed the organism may become endangered or, worse, extinct.) What are some consequences for other organisms? For humans? For the environment?
- What are some reasons we destroy or alter habitats so that wild plants and animals can't live there?
- How is this game of musical chairs similar to what happens to wild plants and animals? Different from what happens to them?
- What are some ways to make this game even more realistic?

Activity 8. Niche Plays

OBJECTIVES

Students will be able to

1) describe the ecological needs and habits of an organism;
2) develop an understanding of an organism's niche; and
3) describe why knowing about the niche of an organism is important in maintaining and preserving biological diversity.

MATERIALS

For the Class

Blackline Master: NICHE NOTES

PROCEDURE

1. Divide the class into groups of four to six children. Assign each group an organism common to the area or one that youngsters know well. These can include predators, prey, decomposers, parasites, herbivores, carnivores, omnivores, producers, and consumers. You can assign plants, too, but they are challenging. Tell the class that each group is going to perform a play illustrating the niche of the organism. Remind students that the niche of an organism is its occupation or profession in the community. The class will try to guess the identity of the organism and its niche. Each group can, within the limitations you specify, make noises, including some dialogue, and props.

2. Review niche if you think it is necessary. You may want to discuss an example, e.g., the niche of "spidering"—of being a spider. It is all things a spider does to get its food and in the process, raise babies. The spider must know what to do to survive. Some spiders build webs; some are swift runners and pounce on their prey (wolf spiders); others build clever traps that their prey wander into (trap-door spiders).

It was mentioned above that plants have niches, too. Think of the niche of "dandelioning"—of being a dandelion. You like disturbed places, like lawns. You are opportunistic and take advantage of situations. Suppose the fresh-turned earth of an earthworm's burrow or a bare spot appears in the lawn. A dandelion seed alights (dandelions make lots of seeds). It grows a deep root that, no matter what you do to the top of the plant, allows it to remain. The plant is lawnmower proof.

Or early spring flowers where the idea is to take advantage of sunlight on a forest floor before leaves on the trees above keep it from getting the light it needs to make food. Try the niche of decomposing (fungi/mushrooms). These are tough challenges but youngsters can be very responsive to them. You know your youngsters and which assignments make sense.

3. Give students some time to make their choice, research the organism, if necessary, and to work on their play. Remind groups that secrecy about their play is important. Distribute copies of the blackline master, NICHE NOTES, to assist them in their research.

4. Use these kinds of questions to discuss the plays.

- Where did the idea for your niche play come from?
- How does the niche of (name organism) compare with the niche of (name organism)?
- How might the human niche affect the lives of organisms in your niche?
- Would you please summarize your ideas on the niche of an organism? (Niche should not be confused with habitat. Niche is about occupation/profession—its role in community life, food relations, effects on other organisms, effect on community and community effects on organisms, even how far and wide it moves.)
- The human niche tends to knock other kinds of plants and animals down (endangered) or out (extinction). What are some ways we could make our niches smaller, still live well and preserve the lives of other passengers on the planet?

EVALUATION

1. Describe a habitat for an animal or plant that lives in your area.

2. Describe the niche of this animal or plant.

3. Describe a habitat of an animal or plant that used to live in your area.

4. Describe the niche of this animal or plant.

5. What are three things that can affect the habitat of an organism?

6. Name three animals or plants that occupy the same habitat and tell how their niches are different.

7. A developer decides to preserve a natural area near a housing development. There are a lot of old trees present. The developer is concerned about safety and has them removed.
- What are two possible negative effects on biological diversity?
- Could there be any positive effects on biological diversity? Why or why not?
- Has the habitat been destroyed or altered? What is the reason for your answer?
- What animal niche might have been affected? How?

RESOURCES

AUDIO-VISUAL

Animal Habitats. 1955. Film Associates. Movie, 11 min. Four different habitats: desert, prairie, forest, and tundra. Grades 3-9.

Estuary. 1981. Bullfrog Films. Movie, 12 min. Grades 4-6.

CLASSROOM

Jim Arnosky. 1983. *Secrets of a Wildlife Watcher*.

Lothrop, Lee and Shepard Books, New York. Althea (Braithwaite). 1980. *Animals at Your Feet*. Dinosaur Publications, Ltd., Cambridge, England.

Midas Dekkers. 1988. *The Nature Book*. MacMillan and Company, New York. Dover Books.

Educational Coloring Books. (e.g., tropical fish, small animals, horses, tropical birds, shells, birds, reptiles and amphibians, fishes, wild animals, trees, wild flowers, weeds, cactus, mushrooms, orchids). Dover Books, New York.

Matthew Kalmenoff. *African Wildlife Dioramas To Cut and Assemble: Full Color Three Dimensional Scenes of Jungle and Plains*. Dover Publications, New York.

David C. Kramer. 1974. *Isopods: The Un-Bugs*. Science and Children, January/February:14-15.

Margaret McIntyre. 1981. *Learning to Observe Animals*. Science and Children, May:24-25.

John Mitchell. 1980. *The Curious Naturalist*. Prentice Hall, Englewood Cliffs, NJ.

Theodore Rowland-Entwistte. 1978. *Animal Homes*. Warwick Press, New York.

Millicent E. Selsam. 1966. *How to Be a Nature Detective*. Harper and Row, New York.

GENERAL

Ronald M. Nowak. 1982. *Our Endangered Species, Then and Now*. National Parks and Conservation Association Publications, Washington, D.C.

U.S. Fish and Wildlife Service, Department of Interior, Washington, DC 20240. (Fact sheet about the Endangered Species Act of 1973; "Biologue" fact sheets on various endangered species; brochures.)

ISOPODS: BACKGROUND AND CARE

BACKGROUND

Pre-visit Activities 2 and 3 cannot be done without first doing Activity 1. All pre-visit activities require the use of live animals called isopods.

Sowbugs and pillbugs are not insects or "bugs." They are land animals that are closely related to crayfish and lobsters and are known as isopods. They have other names, too, such as wood lice, potato bugs and roly-polys. They are found throughout the United States.

There are two common kinds of isopods. One is called a sowbug and the other a pillbug. Sowbugs have broad flattened bodies, can roll over quite easily if placed upside down and have two tail-like appendages. Pillbugs can roll into a tight ball when disturbed. Pillbugs are more sturdy than sowbugs. Pillbugs avoid predators by rolling up into a ball. Sowbugs avoid predators by moving quickly to a hiding place.

Sowbugs are small (a little longer than 1 cm). They prefer dark, moist places and are found under rocks, decaying plant material (leaves, loose bark), boards and logs.

Damp basements provide enough food and moisture for them. Sowbugs can be captured in damp basements by cutting thick slices of potato. Lay one slice over the edge of the other in a dark corner. Sowbugs will be found on the underside of the raised potato slice. Sowbugs are harmless. They are hardy, easy to care for, do not take up much room and make ideal animals for classroom study.

Collecting Sowbugs

If you want, place a raw potato slice (or a small board) outside in a damp, dark, spot. A day or so later you can collect sowbugs that have been attracted to the bait. If students cannot find sowbugs in the schoolyard, have them look for sowbugs at home in their yards.

Guidelines for the Collection of Live Animals

Experiences with live animals can help children develop a sensitivity to their needs and respect for them as living organisms. Emphasize the following:

- Careful searching procedures;
- Non-destructive collecting techniques, e.g., replacing turned-over stones or leaves or small logs;
- Handling organisms carefully; not hurting or damaging them;
- Taking only what is needed for study;
- Returning the organisms to the environment, when the work is completed.

On Keeping Sowbugs in the Classroom

- Use clean, small containers. Containers with steep, slippery sides are best.
- Place moist paper toweling, moist leaves or soil on the bottom of the containers.
- Place some soil in the containers and cover the surface with damp leaves.
- Sowbugs need moisture. Cover the container with a perforated lid. If container lids are not available use a plant mister to keep the study cages moist.
- Sowbugs prefer dark/low-light places. If you want, place toweling or cardboard over their cages when you are not working with them. Do not keep them in the sun.
- Sowbugs can be fed flat potato slices if you want. They should have fresh slices every few days. Students can try a variety of root vegetables.

ISOPOD ENVIRONMENT PREFERENCES

Team Members: _____

The purpose of your investigations is to learn which of at least four environments isopods prefer.

I. Describe the methods you will use to learn this.

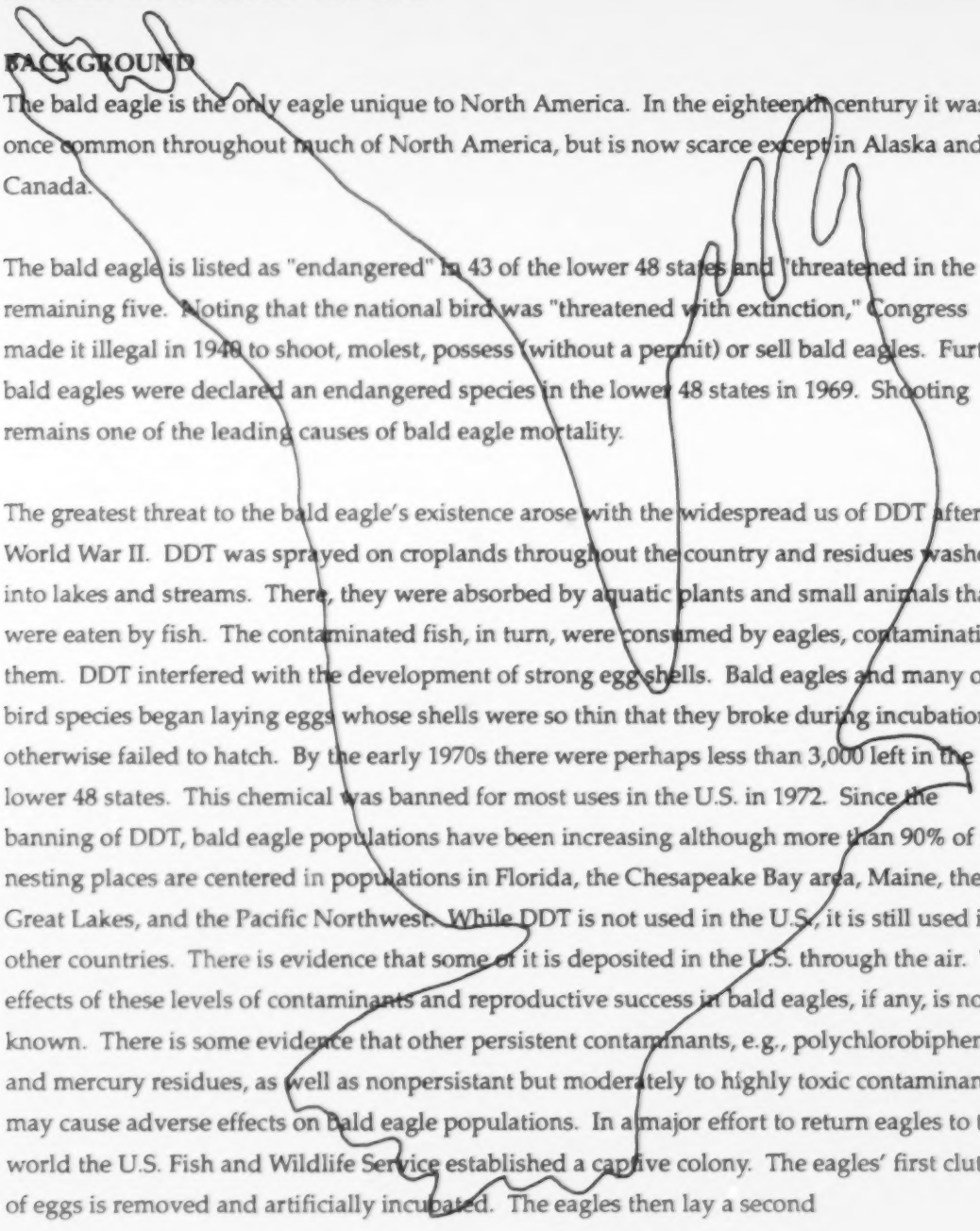
II. Which environments do you think they will prefer? Why?

III. Which environments do you think they will avoid? Why?

IV. What did you observe?

V. What did you learn from this experiment?

NICHE OF A BALD EAGLE



BACKGROUND

The bald eagle is the only eagle unique to North America. In the eighteenth century it was once common throughout much of North America, but is now scarce except in Alaska and Canada.

The bald eagle is listed as "endangered" in 43 of the lower 48 states and "threatened in the remaining five. Noting that the national bird was "threatened with extinction," Congress made it illegal in 1940 to shoot, molest, possess (without a permit) or sell bald eagles. Further, bald eagles were declared an endangered species in the lower 48 states in 1969. Shooting remains one of the leading causes of bald eagle mortality.

The greatest threat to the bald eagle's existence arose with the widespread us of DDT after World War II. DDT was sprayed on croplands throughout the country and residues washed into lakes and streams. There, they were absorbed by aquatic plants and small animals that were eaten by fish. The contaminated fish, in turn, were consumed by eagles, contaminating them. DDT interfered with the development of strong eggshells. Bald eagles and many other bird species began laying eggs whose shells were so thin that they broke during incubation or otherwise failed to hatch. By the early 1970s there were perhaps less than 3,000 left in the lower 48 states. This chemical was banned for most uses in the U.S. in 1972. Since the banning of DDT, bald eagle populations have been increasing although more than 90% of the nesting places are centered in populations in Florida, the Chesapeake Bay area, Maine, the Great Lakes, and the Pacific Northwest. While DDT is not used in the U.S., it is still used in other countries. There is evidence that some of it is deposited in the U.S. through the air. The effects of these levels of contaminants and reproductive success in bald eagles, if any, is not known. There is some evidence that other persistent contaminants, e.g., polychlorobiphenyls and mercury residues, as well as nonpersistant but moderately to highly toxic contaminants may cause adverse effects on bald eagle populations. In a major effort to return eagles to the world the U.S. Fish and Wildlife Service established a captive colony. The eagles' first clutch of eggs is removed and artificially incubated. The eagles then lay a second

clutch themselves. Two methods of reintroduction to the wild are used. In one, 3-week-old eaglets are placed in the nest of adult pairs whose own eggs failed to hatch. The "foster" parents readily adopt the chicks and raise them as their own.

The ancient falconry technique known as hacking is also used. The term comes from the hack, the board on which the hawk's meat was laid and to which it returned. At 8 weeks of age, birds are placed on human-made towers, located in wilderness areas where eagle populations are low. Great care is taken to ensure that the birds have no direct human contact. Gradually, over a period of several weeks, progressively less food is provided to force the young eagles to hunt their own prey and learn to fend for themselves.

From fewer than 3,000 birds and only about 400 known active nests in the early 1970s there are now an estimated 5,000 bald eagles and 1,400 breeding pairs in the continental United States.

Why pay so much attention to a species that is clearly on the comeback? There are a variety of reasons. The bald eagle is sensitive to environmental conservation, habitat deterioration, and human harassment. An interesting answer is found in "Restoring the Bald Eagle" (American Scientist, May-June 1988). One of the authors is Dr. Ted Simons, Gulf Island National Seashore, NPS. Simons and his associates note that bald eagles "are not on the verge of extinction, and when viewed in the context of global conservation needs and of other critically endangered species, the attention may seem misplaced. In fact, it is precisely the symbolic nature of widespread species like the bald eagle—with their ability to capture the imagination of the public—that makes them such worthwhile conservation investments. As symbols of wilderness and of the freedom wilderness represents, bald eagles have the unique capacity to inspire people and to foster a sympathetic attitude toward the needs of other threatened species and toward related environmental issues such as habitat destruction and water quality. Clearly, without that sympathy and the political will it engenders, the needs of more obscure species will go unmet. It may be trickle-down conservation, but in the light of the ever-increasing pressure on global resources, it may prove to be one of the more fruitful conservation strategies available in the years ahead."

◆◆◆

SOME BALD EAGLE NICHE DIMENSIONS

Nesting Southern U.S. populations breed in the winter	**Nesting** Both male and female help in building nest, incubating and caring for young	**Nesting** A spring that is warm enough in April each year so that the animals can nest
Nest trees Widely spread in forest; not close to others	**Nest trees** Easy to get in and out from the air	**Nest trees** Strong limbs
Nests Often reused year after year (may reach 10 ft across; weigh up to 4000 pounds)	**Mating** Pair for life; if one dies, the survivor will take a new mate	**Young** Remain in nest for ten to eleven weeks
Young After leaving nest, young remain with parents during first summer	**Young** During first year after leaving nest, young are larger than parents	**Young** Takes over three years before young look like parents
Once common through much of North America	Requires a clean environment	Female is larger than the male
Few natural enemies		

SOME BALD EAGLE NICHE DIMENSIONS

Food Live fish	**Food** Live sea birds	**Food** Live water birds
Food Live mammals	**Food** Carrion (dead animals)	**Food** Water
Feeding Large area with many fish	**Winter** Near large, ice-free bodies of water	**Winter Roosts** Protected from wind
Summer Large bodies of open water or wetlands	**Nesting** Variety of trees	**Nesting** Mature forest
Nesting Tall trees	**Nesting** Close to shorelines	**Nesting** Little or no human disturbance
Nesting Form attachment to place where raised; tend to return when ready to breed	**Nesting** If eggs are destroyed will lay a second nest	**Nesting** Reluctant to nest right at the shoreline

NICHE NOTES

Name _____

Organism _____

What does it eat? _____

_____

_____

What eats it? _____

_____

_____

What does it do? (Its *profession*) _____

_____

_____

What effects does this organism have on other organisms in its community?

_____

_____

_____

What effects do other organisms in its community have on this organism?

_____

_____

_____

Unit 7

ORGANISMS/ POPULATIONS OF ORGANISMS

OVERVIEW

Children search for organisms in their schoolyard/ neighborhood to find out what lives and grows there. They then try to determine how many organisms there are in a study site. Children participate in games designed to help them understand variation in organisms and population changes. They make decisions about a value laden plant/animal issue. Children play a game and learn some of the factors involved in the endangerment/extinction of small populations.

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TEACHER BACKGROUND

An organism is an individual living thing, e.g., a single frog. The organisms, collectively, inhabiting an area or region are known as a population, e.g., the frog population of a pond.

After more than 200 years of study, scientists have only named and described some 1.7 million different kinds or species of organisms. No one knows how many species there are. Until a few years ago it was believed that there were about 5 million. Based on studies in tropical forests, it has been suggested that there may be 30 million species of insects awaiting discovery!

Extinction is the death of a population of organisms. It has two meanings. "Local" extinction refers to the death of a particular population. "Global" extinction refers to the death of all the populations of a particular species.

Small populations are almost always endangered but there are no valid magic numbers. Populations can become smaller when there are environmental changes, e.g., pollution, when food supply or nesting places become lower in quality or quantity, or habitat is modified. There is widespread agreement that most of this is caused by human activity, often carelessness or ignorance.

Once populations become small they are susceptible to a variety of problems. These include random catastrophe; social dysfunction; inbreeding effects due to loss of genetic variation; variations in birth and death rates or in the number of males and females; variations in the numbers of competitors or predators; and variations in environmental conditions such as weather or fire.

SECTION I. CLASSROOM—PRE-VISIT ACTIVITIES

Activity 1. Organism Search

OBJECTIVES

Students will be able to
1) describe an organism;
2) describe living and non-living environmental factors that may affect an organism;
3) hypothesize on the effects on environmental factors; and
4) define organism as any living thing, plant or animal.

MATERIALS

For the Class
Blackline Master: FINDING OUT WHAT LIVES HERE

For Each Team
1 Magnifier
1 Ruler, metric
Cup, plastic/paper
5-10 Spoons, plastic
5-10 Bug boxes/cups, plastic
Optional: (Aquatic Habitats)
Nets

PROCEDURES

1. Choose an outdoor site for students to study. It should be within walking distance and as diverse as possible.

2. Divide the class into teams of two. Tell students that they will be exploring an outdoor study area to find out what lives there. Distribute two copies of the blackline master, FINDING OUT WHAT LIVES HERE, to each team and review it with them.

3. Once outside point out the boundaries of the study site. There is no reason to dig up plants. Some animals may be easier to study if they are temporarily housed in either a bug box or a cup. Emphasize that one animal is enough. Tell students that you want them to find and observe as many different plants or animals as they can. Ask teams working close to one another to make different choices.

4. When the class is finished have the teams return any plant parts or animals to where they were found. (Students may have used bug boxes or cups for pondweed, snails, crickets, ants, earthworms, and isopods.)

5. When you return to the classroom, have the teams describe what they have found.

6. Summarize the work by asking these kinds of questions:
- Did we get them all?
- If we went back out again do you think we could find new plants or animals? Where would you look?
- If we were to do this at the park, what would you expect to find?
- What are some of your observations?
- What are some examples of living environmental factors? What effect do you think they might have?
- What are some examples of nonliving environmental factors? What effect do you think they might have?
- How many different kinds of environmental factors did we find? Which are there more of, living or nonliving?

7. Tell students that any living thing, plant or animal, is an ORGANISM. Write it on the board where everyone can see it.
- How many organisms did we find?
- How many different kinds of plants? Animals?
- Did we find more plants or animals?
- If we were to spend more time doing this study what other organisms do you think we would see?
- Suppose you were to conduct this work in a field or wooded area at the national park. Would you expect to find the same kinds of organisms? Why or why not? Would it be easier to find different kinds of organisms? Why or why not?
- How could we change the environment to see more organisms? (What if we were to add a bird feeder to the school yard a plant or garden...?)

Activity 2. Population Search: How Many Organisms Live Here?

OBJECTIVES

Students will be able to
1) describe and use a method of studying populations when there are too many organisms to count; and
2) define population, biological diversity and species diversity.

MATERIALS

For the Class
Newsprint/Butcher paper
Tape
Marking Pen
Meter Stick

For Each Team
Envelope/plastic bag

PROCEDURE

1. Choose a study site on either your school lawn or a vacant lot or field. It should measure approximately 15 meters (50 feet) wide by 30 meters (100 feet) long. You can make the required area smaller by dividing the class into teams of three.

2. Divide the class into teams of two or three. Challenge students to find out how many plant organisms live on the study area. Once outside establish the limits of the study area. The investigation involves collecting of plant leaves. Review your conservation rules, especially the collection of a representative sample and not the entire plant or a significant part of it. Give each team an envelope/plastic bag. They are to pick a leaf or an appropriate sample of the plant from the four most common plants they find. (Some plants are complicated and will require more than a single leaf, e.g., creeping charlie.) This should take abut five minutes.

3. Back in the classroom have the team add their finds together to make a graph. Tape a leaf sample at the bottom of each bar. For each plant place an X in the square above it.

4. Write the term POPULATION on the chalkboard and define it as a group of the same kind of organisms that live and reproduce in a particular area. Population refers to the number of individuals. How many populations did we find? Which is the largest? Smallest? Have students rank order the populations on the graph from largest to smallest.

5. Write the term SPECIES on the chalkboard and define it. A species is a group of organisms different from all other kinds of organisms. How many different species are shown on the butcher paper? Are there other species in our study area not shown on the butcher paper? Are humans a species? Name some other species.

6. Write the term BIOLOGICAL DIVERSITY on the chalkboard. In general, it refers to the variety of living organisms found on earth. There are special kinds of biological diversity; one of these is SPECIES DIVERSITY, the number of different kinds of organisms living in an area. Ask students if they found all the diversity present on the study area? How do they know?

No Lawn?

1. Review the above procedures. Use the block around the school: sidewalk cracks, curbsides, trees, vacant lots, even community gardens (after harvest!).

2. You may have to reduce the number of samples collected to two or three. Instruct your class about sampling and conservation. Mosses are especially vulnerable because they are easily removed in large clumps. Point these out and collect a small sample. Instead of each team collecting a sample they could simply note its presence. Collect fallen leaves from the ground rather than from trees.

3. If you have only a sidewalk, choose a section of the sidewalk and let each sidewalk crack represent a study area. Along the way, you are likely to have trees as well as small clumps of plants growing around posts, pipes, and hydrants. Modify the data collection if you include trees. Back in the classroom follow the procedures described above.

EXTENSIONS

1. Save the data and conduct this activity during another season. Compare populations and species diversity.

2. Taxonomy, the scientific system used to classify and name living things, divides organisms into progressively smaller and more specific groups. Species is the basic unit of the system. Each species has its own unique two part or binomial name. It is like having a first and a last name. Scientists traditionally use words from Latin or Greek for these names. All organisms of the same kind have the same first and last name. *Homo sapiens*, for example, the binomial name for the human species, translates into "wise man." *Canis familiarus* is the scientific name for the "common dog." *Taraxacum officinale* is the common dandelion. *Ursus horribilus* is the grizzly bear. It means "horrible bear." These are the scientific names for all humans, dogs, dandelions and grizzly bears. We may know humans as Tim or Mary Jones, the dog as Spot, the dandelion as teeth of the lion or the grizzly bear as "Snaggletooth" or "105" (Numbers are used when scientists tag animals.). Challenge students to find the scientific name of a common animal or plant and make a scientific name bulletin board. Post the common name, the scientific name, and when possible, the meaning of the name.

SECTION II. NATIONAL PARK—ON-SITE ACTIVITIES

Activity 3. Organism Variation Games

OBJECTIVE

Students will be able to define the concept of variation (organism variation), a level of biological diversity.

No materials required

PROCEDURES

1. Have students stand in a circle. Tell them that they are going to act as animals doing some of the things they do in their daily lives. Tell youngsters that in these activities the person immediately to their right is their partner.

a. **Rabbit Hop**
You, as teacher, play the role of a predator. When you scream or bark or roar, rabbits spring forward as far as possible. The rabbit who leaps the farthest is the wins; it gets away. The other is caught.

b. **Heron Stand**
Tell the "herons" to stand on their right foot as long as possible; then stand on their left foot. The winner is the one who stands the longest in each stand-off!

c. **Owl Stare**
Tell the students "You are owls." Stand fairly close but do not touch, and face each other. Gently close your eyes and when you hear me say "stare down," owls stare at each other. Owls may click their bills, hunch up their shoulders to look larger and fiercer, and raise and flap their wings. The owl who stares the longest without blinking is the winner.

7-7

2. Review the games with the youngsters. Did the same ones win each time? What are some reasons for the differences from game-to-game?

3. Define these natural differences as VARIATIONS. Variations in organisms are both physical (e.g., leaping/hopping; standing) and behavioral (e.g., staring). Ask kids to give some other examples of variations among them. Emphasize that differences exist in any group of organisms of the same kind. Ask kids to tell you the scientific term used to describe organisms of the same kind (species).

4. When it is appropriate throughout the remainder of the kids' park interpretive experience, ask kids to point out variations among species.

EXTENSIONS

1. Add other organisms and challenges to this game of species variation.

2. Where appropriate have kids point out producer, consumer, and decomposer organisms. Remind them that these are required for a self-sustaining community.

Activity 4. Population Game

OBJECTIVES

Students will be able to
1) identify the three essential components of habitat—food, water and cover; and
2) discuss the different factors such as predators and weather conditions.

MATERIALS

4 Frisbees Numbered 1 - 4
Cap, stocking
Cards

PROCEDURES

1. Mark off a circle approximately ten to fifteen meters in diameter. On it place frisbees numbered 1 through 4 to designate bases spaced equal distances apart. Parents/chaperones, backpacks and you can be used as bases, too.

2. Explain to the youngsters that in your cap are seven different kinds of cards: organism (5), food (4), water (4), cover (4), predator (4), weather (4), and habitat destruction (4). Pick out specific organisms and a predator (plant or animal) and modify any of the cards to suit the conditions of organisms and conditions in the park, e.g., one interpreter used fish (walleye), food (leeches), predator (osprey), and other elements listed and titled it the fish-niche game. Ask kids to define a population (A group of organisms of one kind living together in a particular area.).

Review the concept of cover. It refers to shelter provided by plants or the environment. These provide places to hide, rest, sleep, play and raise young. Such needs can vary throughout the year. Depending on the park conditions and your modifications of this short game you may want to describe special kinds of cover, e.g., winter, loafing, roosting, nesting, and escape.

3. Have the children count off in fours. Have the children draw a card from the cap and tell them to keep their identities secret. They should hang on to their cards and go to the base that corresponds to their number.

4. Count from one to ten. As you do so children are to run around the bases and when you get to ten they should go to the nearest base.

5. Ask kids playing the role of organisms in the population of _____ to raise their hands. Ask kids playing the role of habitat destruction to raise their hands. The group or groups with habitat destruction do not win. Then ask the remaining groups to check whether they have at least one food, water, cover, predator and weather condition. If so, they are winners. This may be an appropriate time to review the role of predators and weather as natural components in a population of organisms and contrast that with habitat destruction. Did the population increase, decrease, or stay the same?

6. Play at least another round. Have the kids put their cards back into the cap, then have them draw again. Was the result the same?

7. Summarize the game by briefly discussing the game.
- What are some causes of habitat destruction?
- In this game what determined the success of the population? (Habitat destruction; presence or absence of one of the essential elements of habitat—food, water, cover.)
- Populations of _____ (name) also live in areas outside the park. What are some ways that the life of a population inside the park may be different from the life of a population outside the park?

- If a population lives part of the time inside and part of the time outside the park, is it easier or harder for this population to survive? What are your reasons?
- If there were no habitat destruction would you expect the population of a group of organisms to increase, decrease, or stay about the same? What are your reasons?

SECTION III. CLASSROOM—POST-VISIT ACTIVITIES

Activity 5. Decision Making

OBJECTIVES

Students will be able to
1) discuss some of the problems that wild plants and animals face from humans;
2) give examples of how personal feelings and beliefs can affect situations involving wild organisms; and
3) make decisions about a value-related plant/animal issue.

MATERIALS

For Each Team
Blackline Master: BEFORE AND AFTER

PROCEDURE

1. Divide the class into small groups of two to three students.

2. Distribute copies of the blackline master: BEFORE AND AFTER.

3. Ask the students to study the illustration and then answer the questions.

4. When students are finished debrief the work with them.
• What populations are most affected by this development? Least affected? How do you know?
• Would you expect any organisms to become extinct as a result of this development? Which ones? Why do you think they might?

7-11

• Could any populations become extinct as a result of this development? Why do you believe your view is correct? (Some kinds of plants and animals naturally occur in a small number of populations or have been reduced to them by human activities. An example of the former may have been the extinct passenger pigeon. It is possible that there may have been only a few gigantic populations. An example of the latter is the Houston toad. Almost all of its habitat has been paved over or built on. It survives in only two small areas in east Texas. Such populations are highly susceptible to extinction.)
• Review some of the alternatives and consequences you discussed? What are possible consequences of this alternative on organisms? Populations?
• Humans interfere with organisms and populations of plants animals to improve their lives. What guidelines do you think should be established when it comes to using the environment?

EXTENSIONS

1. The United States Endangered Species Act of 1973 is the premier legislation in the world to protect species. It requires the secretary of the interior to list all species that are endangered or threatened with extinction. The list currently stands at about 1,000 species including more than 300 species of mammals, 200 birds, 100 reptiles, 100 fish, 200 plants and a smattering of amphibians (e.g., frogs, toads), insects, mollusks (e.g., clams), and crustaceans (e.g., lobsters, crabs, crayfish).

Over 500 of the listed species occur outside the United States. There are about 3,000 species that are on a list of potential candidates for listing. This list does not represent the actual distribution of rare organisms. Insects are probably becoming extinct faster than any other group of organisms. The trouble is we don't know much about names of them or we don't know they exist. A number of surveys have shown that there are far more species of insects than we have realized.

Listing an organism does not guarantee its survival. The Palos Verdes blue butterfly was exterminated when a local unit of government knowingly and intentionally decided to turn the meadow that was its habitat into a softball field. Present your students with this problem and prepare some study questions, e.g.,
• How could a thing like this happen? What are your ideas?
• What should we do if this happens?
• What should we do to prevent this from happening again? What are your ideas?
• What suggestions do you have that would help people make decisions to protect plants and animals?

Activity 6. Going...Going...Gone

OBJECTIVE
Students will be able to describe some of the factors involved in the extinction of small populations.

MATERIALS
For Each Team
1 Marker, permanent
3 Scissors
3 Sheets of construction paper, different colors
Plastic lid, rimmed
1 Paper fastener
1 Safety pin
1 Container, e.g., margarine bowl
1 die (optional)

PROCEDURE
1. Divide the class into groups of three. Have them gather the materials. Each team member is to cut out six uniformly shaped fish from one of the sheets of colored construction paper. The fish should fit the container. The six fish of the same color represent one population for example: blue=bluegill; red=salmon; green=northern pike. Select kinds of fish found in your area.

2. Show youngsters how to make a spinner. Use a permanent marker to divide the upper surface of the lid into three equal sections. Label them *keep*, *release* and *no fish*. Insert a metal paper fastener through the closed end of a safety pin, push the fastener through the center of the lid, and spread its ends apart.

3. Challenge players to predict how many fish can be removed before a population becomes extinct.

4. Review the rules:
- Tell teams who goes first, second and third. Use either the paper colors or have each team use a die with the player rolling the highest number starting first and so on.
- Each player takes a turn. If the spinner lands exactly on a line, the player spins again.
- Each player fishes for her or his group's color of fish.
- When the spinner lands on *keep*, remove a fish. When it lands on *no fish*, no fish are removed, the same as going fishing and having "no luck." When it lands on *release*, remove the fish but return it to the "lake."

5. Use these kinds of questions to discuss the activity:
• What caused the extinction of this population?
• What are some possible effects the extinction of the population could have on the other fish populations?
• How could you prevent the population that went extinct from going extinct? Are there some other ways?

6. Play the game again with the same rules or change them, e.g.,
• Have students select the color of fish they want when they catch one (They are experts at fishing.);
• Fish "blind," i.e., the player closes her or his eyes when the fish they caught is removed from the container (They are amateurs at fishing.); and
• Decrease the size of one of the populations.

EVALUATION

1. Describe the difference between an organism and a population.
2. Describe two reasons for concern when a population becomes extinct.
3. What are two factors that might make a population increase?
4. What are two ways humans might make a population increase?
5. What are two factors that might make a population decrease?
6. What are two things humans might do to make a population decrease?
7. The following are several events that can occur in nature. Circle the worst one and explain why. Organism death, population extinction, species extinction.

RESOURCES

CLASSROOM

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GENERAL

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Gene Logsdon. 1983. *Wildlife in Your Garden*. Rodale Press, Emmaus, PA.

FINDING OUT WHAT LIVES HERE

Team Members: _____

1. Choose a plant or animal to observe.
a. If you know the plant or animal, name it. _____

If you don't know its name, invent one that describes either what it looks like or something that it does.

b. Describe the plant or animal. Use the other side to make a drawing. _____

_____

_____

_____

c. Describe the place the plant or animal lives—its habitat. Is it sunny, shady, in the open, surrounded by many plants, on the ground, 10 feet in the air, 30 feet in the air, under a rock, in a moist or dry place, under water, other?

_____

_____

_____

_____

_____

2. What might change this animal or plant home? Give three examples and tell how the habitat might change.

a. _____

_____

b. _____

_____

c. _____

_____

BEFORE AND AFTER

Team Members: _____

STUDY QUESTIONS

A luxury townhouse complex is being built in an open, natural space along the river across from a downtown metropolitan area. What are your ideas about what happens when a space like this is changed?

2. Below are listed some parts of the environment that will be affected in some way. What are some of the consequences of the development?

CONSEQUENCES

To animals _____

To plants _____

To humans _____

To the environment _____

3. What alternative courses of action might be considered?
4. The human population is growing. We need places to shop, build homes and to provide entertainment/recreation. What alternatives to this project could be considered?
5. For each alternative describe some consequences of the action you are considering.

ALTERNATIVE	CONSEQUENCES

Unit 8

ADAPTATION/CHANGE

OVERVIEW

In this collection of activities students learn about the concept of adaptation. Through time, plants and animals become marvelously fitted to their environments. However, human activities are dramatically changing environments. Many plants and animals are unable to keep up with these changes and are threatened with extinction. Students learn about adaptation through creative invention, interpretation experiences, exploration of animal coverings and a game based on a popular television program.

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TEACHER BACKGROUND

An adaptation is a physical or behavioral feature of a plant or animal that helps it survive in its habitat. Adaptation is an ongoing process in which the population is always adapting to the environment. However, populations are always at the mercy of sudden and dramatic changes in the environment. The difference between the persistence and extinction of a population of organisms is a result of the population either being able to keep pace or not keep pace with changes in the environment. This is referred to as adaptability.

Before Europeans appeared in North America the currently endangered gray wolf was widespread and numerous. Today there is much less wild habitat and the wolf, which is basically a shy animal when it comes to humans, is barely holding its own. It is fair to say that the wolf is still well adapted to wild habitats; it is not adaptable to the changes that have occurred in these habitats. On the other hand, a relative, the coyote, is probably more abundant than it has ever been. When it comes to co-existing with humans it is quite fearless and is able to scavenge for food. In these respects, the wolf is less adaptable than the coyote to the new conditions created by humans. This is true for most organisms.

Most losses of biodiversity are unintended consequences of human activity, and the species and populations affected are usually not even recognized. Forces that contribute to the worldwide loss of biological diversity are varied and complex, and stem from both direct and indirect pressures. The green turtle is an example of a species threatened by direct factors, such as exploitation of adults and eggs, and by indirect factors, including nesting beach destruction, ocean pollution, and incidental catch by shrimp trawlers. All of these are examples of changes in the green turtle's environment to which it cannot adapt.

SECTION I. CLASSROOM—PRE-VISIT ACTIVITIES

Activity 1. An Organism for a Schoolyard

OBJECTIVE

Students will be able to describe several ways plants and animals are adapted to the schoolyard habitat.

MATERIALS

For the Class

Construction paper
Tape (mailing and transparent)
Scissors
Stapler
Rubber bands
String
Toothpicks
Paper towels
Straws (paper or plastic)
Paints, poster
Containers (small for paints)
Brushes
Water
2 rolls of toilet paper

PROCEDURE

1. Have the class describe their schoolyard habitat. Remind students that habitat is the place where an organism lives. Ask what kinds of problems do plants or animals have in living in the schoolyard habitat? List these on the board and ask how the organisms have solved some of these problems.

2. Have the class count off by two's. The one's are animals; the two's are plants. Challenge each student to design an animal/plant which could survive in the schoolyard.

3. Ask the students to use the materials provided to construct a three dimensional model of their animal or plant. The model can be stuffed with toilet paper to make it three dimensional. Before students become too deeply involved in their work, you may want to take a student field trip through the schoolyard so that they can think about their organism in this unique habitat.

4. After everyone has finished, have youngsters present their plant/animal designs to the rest of the group. Each presenter should:

- Name (descriptive name) the organism, and
- Describe at least one thing about the organism that helps it survive in the schoolyard habitat.

5. Write ADAPTATION on the chalkboard and tell students that it is any feature of an organism that helps it survive. Write ADAPT on the chalkboard and tell students that it means to adjust to environmental conditions. Ask students to describe some of the adaptations of the plants and animals they invented. To what environmental conditions have their plants/animals adjusted?

6. Take a walk on the schoolyard and discuss some of the adaptations of plants and animals.
•How are dandelions adapted to the conditions of the schoolground? (Leaves in contact with the ground; stems grow rapidly; produce a lot of seeds; hardy—withstand trampling, grow in cracks in sidewalks; deep roots—very difficult to remove plant, it will grow back even when a lot of its root is removed.)
•How are earthworms adapted to the conditions of this habitat? (Live in the soil; come out at night; feed on decaying plants and animals.)
•How are birds adapted to this habitat? (Nest in trees; feed/drink on schoolgrounds or fly to food or water; if there is a resident winter population note where they stay; if the population migrates note that.)

7. Summarize the work with a brief discussion:
•What would happen to their creatures if the habitat changed, e.g., if a shopping mall was constructed there or if it became warmer and dryer as a result of the greenhouse effect?
•Are extinct proof animals or plants possible?
•Is there more diversity in the schoolyard habitat or a natural area? Why?

Activity 2. Critter Watchers

OBJECTIVE

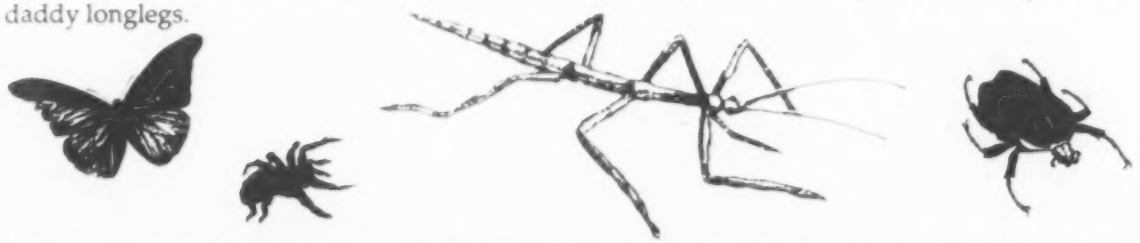
Students will be able to describe ways in which animals are adapted to their environments, especially features of coloration.

MATERIALS

Art supplies, e.g., pipe cleaners, tagboard, construction paper, markers, floral tape, thin aluminum wire, cottonballs, toothpicks, yarn, paints, rubber bands, paintbrushes, scissors, tape, paper towels, newspapers.

PROCEDURES

1. Select a 15 to 20 m (approximately 50′ to 80′) section of "trail" from your schoolyard and walk it with your students. Tell students that when they return to the classroom they are to make camouflaged organisms that can be concealed against the background of the trail's habitat. Ask youngsters to make some suggestions for places to naturally conceal their organisms. They may forget leaves of bushes and trees. Tell them that their organisms cannot be covered by leaves or stones. Insects and spiders are likely candidates—butterflies, moths, caterpillars, walking sticks, daddy longlegs.



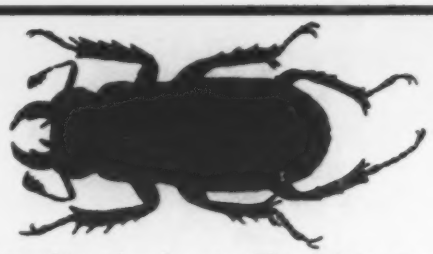
2. Have students place their camouflaged organisms along the trail as secretly as possible. Then, have the class walk the trail from beginning to end. Challenge students to try to spot and count as many of the organisms as they can. All of this should be done as silently as possible. Youngsters are not to pick up or remove the organisms, point to them, or indicate that the organism has been seen.

3. When the class reaches the end of the trail ask them to tell you how many they saw. If no one is right tell them "we missed some." As you rewalk the trail, ask youngsters to point the organisms out, discuss characteristics that conceal/reveal the organism, and collect them.

4. Back in the classroom, summarize the work by asking these kinds of questions:

- What are some ways in which insects are adapted?
- Insects appear to be quite resistant to extinction. What are some reasons that they are so hardy? (Mention their remarkable ability to resist insecticides.)
- What are some things to which a population of animals may not be able to adapt? What happens then?
- What are some populations of animals that have had a difficult time adapting to humans? What is being done about them?

5. End with a discussion of adaptation, a feature of an organism that helps it survive. In insects this includes not only camouflage but also weapons (chemical sprays, biting jaws, stingers), freezing/"playing dead," escape (flight, running), looking like something you're not (mimicry), and surprise (eyespots).



Some organisms are colored for visibility, e.g., bumblebees, butterflies, skunks, etc. This is known as advertising coloration. It attracts attention. Monarch butterflies have very prominent orange-and-black wings. This "tells" would-be predators that they are a very disagreeable-tasting meal. (Monarchs obtain the poisonous substances from milkweed plants.) Blue jays learn to avoid monarchs very quickly. The first time they eat one, they eat only part of it and vomit. They do not make this mistake again!

8-6

SECTION II. NATIONAL PARK—ON-SITE ACTIVITIES

Activity 3. Surprising Guests

OBJECTIVES

Students will be able to
1) describe adaptations of a species;
2) describe the interrelationships between individual parts of a species; and
3) compare adaptations between species.

MATERIALS

Poster boards (see below)

PROCEDURE

1. Pick two animal species that are found in your park. Choose threatened/endangered species if possible and prepare two poster boards on each of them that emphasize adaptations in terms of parts/whole relationships, i.e., significant adaptational components and how the parts contribute to the successful survival of the organism. If possible and appropriate, use real body parts.

2. This activity is probably best done close to a building where you can store the props and where you can get two student volunteers out of sight of the group. It should be done at the beginning of the park visit. Tell the group that you need two volunteers to help you with a couple of critters. Tell the rest of the students that while you are gone, you want them to be especially quietly. The critters that will visit them are not used to seeing large groups and noise frightens them. When you have the two volunteers out of sight, instruct them in a brief role play, e.g., if one of the posters is on a wading bird, instruct the student on how to move like one; or if one of the organisms is a fish have the student move sinuously. As you walk out with the posters, quiet the group with a "s-h-h-h-h, they are coming" and have your volunteers appear, acting out the animals they represent.

3. Use the posters to provide a brief overview of the animals.
- Ask students to identify some adaptations of the organism? How do they help the animal survive?
- Ask kids to imagine that the animal was hurt. How would the animal be affected by damage to _____ (name the part)? What would be the most serious part to be hurt? Least serious? Why?
- How do these parts work together in the survival of the organism?
- What adaptations are similar between the two species? Different? (Remind students that species is a group of organisms different from all other organisms.)
- If you use threatened/endangered species, describe the ways the species protects itself. Point out the things in its environment to which it is not adapted.
- Ask students if they think humans should be permitted to threaten the life of another species with extinction? What are their views? What guidelines would they establish for human beings? How would they control the guidelines?

4. After the discussion, lead the students on a hike. Stop at specific plants and animals along the trail and ask students how those plants and animals are adapted to that environment.

Activity 4. Mirror, Mirror

OBJECTIVES

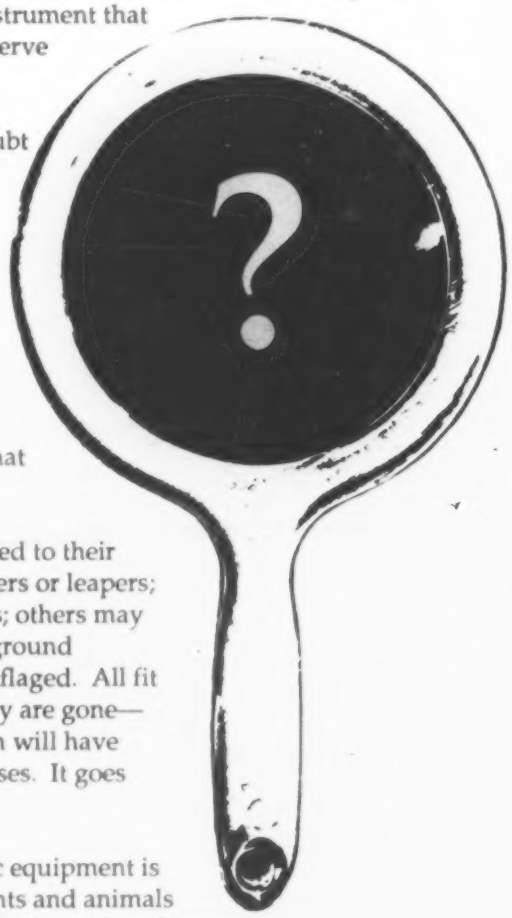
Students will be able to
1) cite the world's species that has the greatest impact on biological diversity—both positive and negative; and
2) describe some ways that biological diversity is important to humans.

MATERIALS

Mirror

PROCEDURE

1. Carry the mirror in your backpack. At an appropriate time—after about an hour—explain to the kids that in your backpack is a delicate scientific instrument that can show them something that either can threaten or preserve the biological diversity of the Earth.



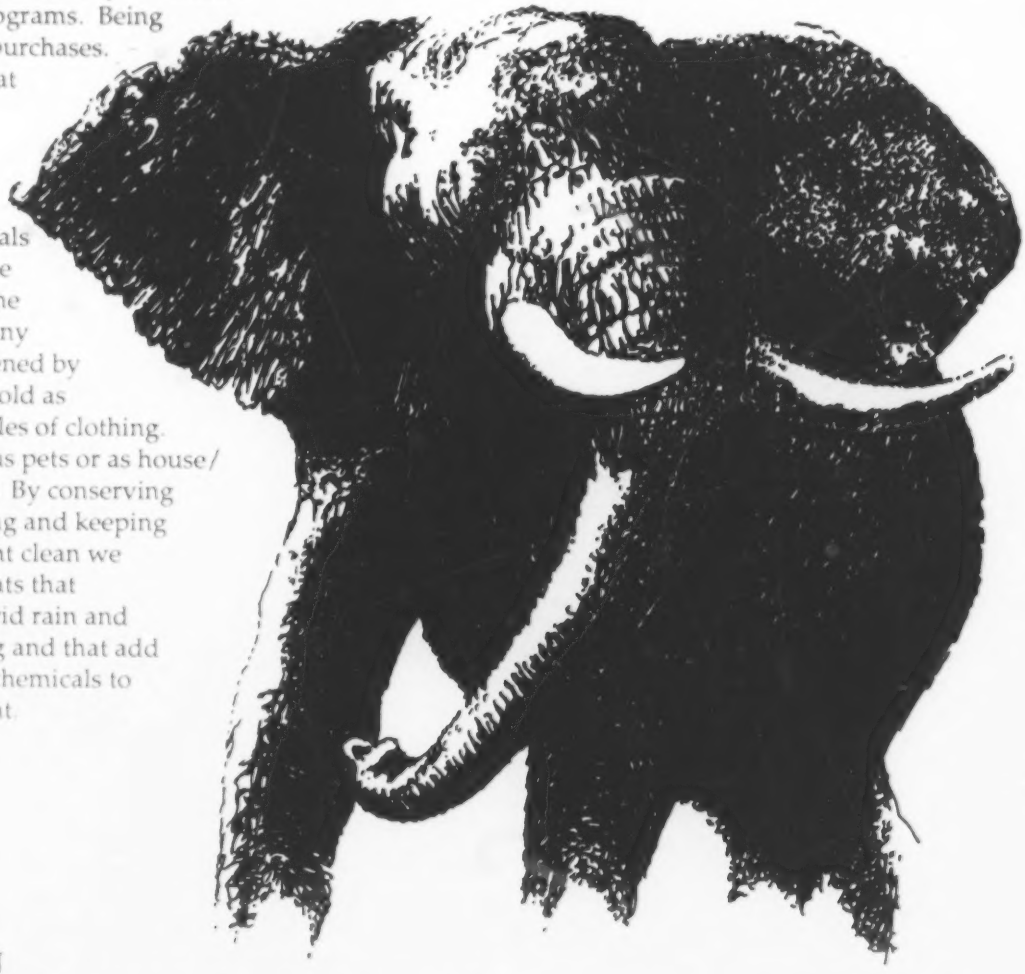
2. Ask kids about how long they have been here. (No doubt they will be so excited by the park experience that they will underestimate the time. If so, take it from there.) Tell them that every hour as many as three species may become extinct—gone forever from the face of the earth. By the time you leave, two to three species will have become extinct—gone forever. There is considerable disagreement among scientists about the number of species lost on an hourly basis. Stress that the majority of these losses occur in the insect world and most in the tropics. If you want, ask youngsters how many species that is in a day. (48-72)

3. Tell students that those plants and animals were adapted to their environment. Some of them might have been great jumpers or leapers; others might have made beautiful sounds to attract mates; others may have been protected by armour; others were great underground burrowers; many of the organisms may have been camouflaged. All fit into the habitat in which they lived and had jobs. But they are gone—lost forever. By the time you get home another half dozen will have disappeared. Most of us don't even think about these losses. It goes on and on and on, hour after hour, day-by-day.

4. Then ask, "What do you suppose this piece of scientific equipment is that can tell us the answer to an adaptation that most plants and animals can't make?" When everyone is within viewing distance pull out the mirror and have the students look into it.

5. Help students to understand that the health of the Earth ...of the park ...of the places where we live depends on us. It is not only our health but the health of the environment and of all the plants and animals. We need nature. It provides foods, medicines, transportation, clothing and a lot of satisfaction.

6. Tell students that this instrument also shows them the only thing that can save biodiversity. "It's up to you to do something, not wait around for *someone else* to do it for you!" Ask, "What are some ways we can do our share to conserve biological diversity?" Some possible answers include learning about biological diversity in schools and in park programs. Being careful in our purchases. How would that help? (Some materials contained in spray cans contain chemicals that damage the ozone layer. The products of many animals threatened by extinction are sold as jewelry or articles of clothing. Some are sold as pets or as house/garden plants.) By conserving energy, recycling and keeping the environment clean we reduce pollutants that contribute to acid rain and global warming and that add other harmful chemicals to the environment.



EXTENSION

1. Make a short tape of a variety of construction sounds from chain saws to bulldozers to hammers, saws and nailing. Include the sounds of humans shopping, playing, working, laughing, and perhaps even discussing biological diversity. This may "sound" out of place in a park but the contrast is powerful enough so that you can almost ask "how does such development *sound* to the natural world?"

SECTION III. CLASSROOM—POST-VISIT ACTIVITIES

Activity 5. Those Adaptable Coverings

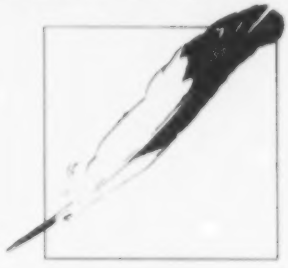
OBJECTIVES

Students will be able to
1) describe similarities and differences between plant and animal coverings; and
2) describe adaptations of plant and animal coverings.

MATERIALS

For the Class

Variety of animal and plant coverings, including animal (e.g., crayfish/lobster shells, hair, feathers, fish scales, fur-pieces), insects, molted reptile skins, shells; fruit (e.g., apple, banana, grape, kiwi, lemon, orange, melons); nut (e.g., acorn, almond, brazil nut, filbert, peanut, sunflower) and vegetable (e.g., carrot, corn, onion, peas, potato, squash).
Magnifiers
Newspaper
Paper towels



For Each Team

Container
Water
Blackline Master: PLANT AND ANIMAL OUTSIDES

PROCEDURE

1. Divide the class into groups of two to three and have them spread newspaper on their work surfaces.

2. Give each group a variety of coverings and a copy of the blackline master, PLANT AND ANIMAL OUTSIDES, and have them complete it.

3. When students are finished with their observations and investigations debrief their work with these kinds of questions:
- What are some categories for plant and animal coverings? How did you classify them?
- What did you notice about these coverings? About their texture? Color? Hardness or softness? Strength? Odor? Resistance to water?
- What is the biggest difference between plant and animal skins?
- How has this organism adapted to its surroundings? (Choose a plant or animal.)
- What are some of the uses of coverings in plants and animals?

- No matter how humans use the covering of wild animals, the animal is dead. Should we continue to use wild animals to make such things as coats, shoes, and handbags? Why or why not?
- Are there any uses of wild animal coverings by humans that are alright? Which ones? What are you assuming?
- There are ways of raising some wild animals. As a result we know that the coverings they provide us are not from endangered species. This is often called ranching and the animal covering is often identified as such, e.g., "ranched cowhide." Where do you stand on this topic?
- What are some good uses of animal coverings? Bad uses?
- What would you suggest as an alternative to a person who wanted to purchase something made from an animal covering? What is a consequence of your suggestion?

Activity 6. Win, Lose or Adapt

OBJECTIVES

Students will be able to
1) recognize that humans are animals with adaptations which make us different from other animals; and
2) identify two adaptations and tell how these adaptations help them in their habitat.

MATERIALS

For the Class
Chalkboard
Markers
15-20 Adaptation cards, 3 x 5" index cards
Watch
Blackline Master: GAME CARDS

PROCEDURES

1. Make a copy of the blackline master, GAME CARDS and cut them up or use the following list with your class to prepare a set of 15-20 adaptation cards. This is a list of suggestions. They are to be modified and added to, based on your experience and your class. They are underlined to help you separate them.

Insects
Antennae—used to feel, smell and, in some insects, to hear
Compound eyes—often the biggest; many lenses
Mouthpart—Female mosquito's is needle like
Hard outer covering exoskeleton—protection from enemies; keeps from drying out, waterproof
Camouflage—moths, walking sticks, for protection
Biting jaws—ants, for working and carrying food
Stingers—bees, wasps for protection
Eyespots—moths often have huge eyespots on their wings to scare off predators

Reptiles
Slimy skin—frogs, keeps skin moist and helps them breathe
Long, fast tongues—lizards use them to zap food
Forked tongues—snakes use it to "smell" their environment
Hard shell—turtles, protects body
"Fifth hand"—A chameleon can wrap its tail around a twig or branch for support

Birds

a. Beaks

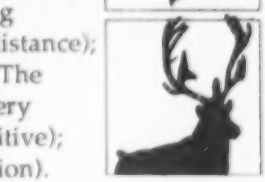
Hooked beak—for tearing up food, raptors (hawks, eagles)
Pouch-like beak—for carrying food, pelican
Long-hollow beak—reach nectar deep inside blossoms, humming-bird
Short, cone-shaped beak— strong for opening seeds, cardinals and sparrows
Long thin beak—to probe for food in mud, many shorebirds such as curlews, godwits, snipes

b. Feet

Feet for climbing—woodpecker, two toes in front and two in back
Feet for grasping—hawks and owls, large curved claws, called talons to dig into and hold prey
Feet for perching—robins, chickens, three toes forward, one long hind toe, sit on branches
Running feet—two toes on the ostrich; three on the killdeer, all pointed forward)
Swimming feet—ducks, aids in swimming, walking on mud

Mammals

Paws with claws—most meat eaters, to climb, dig for food or a home, hold their prey
Long pointed canines—most meat eaters, to stab and kill prey
Hooves—deer, antelope, running
Teeth that never stop growing—mice, rats, squirrels, beavers, muskrats, teeth to last a life-time of eating nuts, trees, snipping off stems/branches
Fur covered feet—rabbits and hares, good grip on slippery surfaces
Spine- or quill-covered bodies—porcupines, protection from predators
Horns—bighorn sheep, bison—permanent, slow growing, for defense, mating fights
Antlers—deer, moose, elk, caribou, used for defense, mating fights, fast growing
Whiskers—lions, wolves, coyotes, help animal to feel the environment when going through brush or small places, especially in the dark
Eyelashes—wolves, coyotes, keeps dust and other material out of eyes
Hair—all mammals (some have more than others to keep heat in or cold out, protection —porcupine quills are hair!)



Ask students to suggest adaptations of humans and list them on the board. As students list them, ask them to describe the adaptation and how it is useful to humans. Some possible examples might include: upright posture (carrying objects, seeing distant objects, holding and throwing objects); eyes face forward (helps judge distance); movable neck; ear lobes (help gather sound); big brains (intelligence); thumbs (The specialty is an opposable thumb. It can touch the tips of the fingers allowing very precise and delicate hand movements.); touch (fingers and hands are very sensitive); live in groups (cooperation, safety in numbers); speech (conversation, cooperation).

2. Tell students that they are going to play a game based on animal adaptations. It is based on a TV game show. The difference is that they will draw different animal adaptations.
a. Divide the class into two teams.
b. One person from the team picks an adaptation card and, in one minute, tries to draw it for the others on her or his team who are trying to guess it. As team one is guessing, if someone says one word of the adaptation or a portion of a word, the teacher writes the word on the board.
c. If team one does not guess the adaptation after a minute, team two gets a chance to steal. Five points are awarded for a correct answer.
d. The game then alternates and team two draws and guesses. After the adaptation is guessed (or not guessed), everyone is to be quiet for a discussion of the adaptation. Include which animal or animals have this adaptation and how it helps them.
e. If possible, try to end the game so that it ends in a tie (or is very close) to avoid one team being a loser. One way this can be done is by insuring that the leading team draws more difficult adaptations.

3. Use these kinds of questions to summarize the activity:
• What is the importance of adaptation to organisms?
• If humans destroy habitat what are some adaptations of animals that might be affected? What if we made the earth warmer through the greenhouse effect? Acid rain? Use water—fresh and oceans—as dumps for solid waste? What are some adaptations of animals that might be affected through human carelessness?
• What are some adaptations (or an adaptation) that might make an animal very susceptible to extinction? (Very specialized adaptations such as to very small chunks of habitat or food.)

The Dusky seaside sparrow is the nation's first bird to become extinct since the endangered species list was created in 1966. The last known Dusky sparrow died in June 1987. It once numbered in the thousands in the natural salt marshes in Florida. Many of these were around Cape Canaveral, the major launching area for U.S. space efforts. The Dusky sparrow was adapted to life in these salt marshes and was the victim, primarily of human uses of its habitat although DDT played a role. The Tecopa pupfish spent its life in steamy, salt waters around Death Valley. It was the first animal to be removed from the endangered species list because of extinction. As resorts developed, its environment—small desert ponds—dried up and the Tecopa pupfish population died.

EXTENSION

1. Play "Thumbless Relay," Amazing Mammals, Part II. Available from National Wildlife Federation. See RESOURCES.

EVALUATION

1. Describe three problems an animal you saw at the national park would have if it were suddenly transferred to the area of your school. Could these problems be solved? Why or why not?

2. Give three examples of animal adaptations. Which one is most similar to a human adaptation? Explain your reasoning.

3. Write down everything you can about the harpy eagle based on the following diagram.

4. What are two things you can do to help prevent extinction of the earth's biodiversity?

RESOURCES

CLASSROOM

Margaret W. Buck. 1958. *Where They Go In Winter*. Abingdon: Nashville, TN.

Joanna Cole and Jerome Wexler. 1979. *Find the Hidden Insect*. Morrow: New York, NY.

Sam Epstein and Beryl Epstein with Michael Salmon. 1985. *What's for Lunch? The Eating Habits of Seashore Creatures*. MacMillan: New York, NY.

John H. Falk. 1973. *Lawn Guide: A Guide for Identifying Organisms Found In and Around the Lawn*, in Outdoor Biological Instructional Strategies, University of California, Berkeley. (Delta Education, Box M, Nashua, NH 03061.)

NatureScope. National Wildlife Federation, 1412 Sixteenth Street NW, Washington, DC 20036. (Activities on Adaptations are found in *Incredible Insects, Let's Hear It for Herps, Amazing Mammals, Part I and Part II*)

Outdoor Biology Instructional Strategies. Adaptations and Bio-Crafts. Delta Education, Box M, Nashua, NH 03061. (Construction and invention activities that introduce youngsters to adaptations of plants and animals.)

Dorothy H. Patent. 1979. *Shapes in Nature: What They Mean*. Holiday, New York, NY.Project Wild, K-6. Salina Route, Boulder, CO 80302. (Activities on adaptation in section titled *Ecological Principles*.)

Dorothy Shuttlesworth. 1966. *Animal Camouflage*. The Natural History Press: Garden City NY.

PLANT AND ANIMAL OUTSIDES

TEAM MEMBERS

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1. Notice everything you can about these coverings. Describe texture, hardness or softness, color, odor, and hardness. Conduct water tests. Look sharply; use the magnifiers. Write down your observations.

2. Name the coverings that are similar and explain why. Then name the coverings that are different and explain why.

SIMILAR COVERINGS	WHY

DIFFERENT COVERINGS	WHY

How do each of the coverings help the animal or plant adapt to its environment? Write the name of the covering and list the adaptations.

COVERINGS	ADAPTATIONS

5. How are the plant and animal coverings different?

GAME CARDS

Compound eyes Often the biggest, with many lenses	**Stingers** Bees, wasps, for protection	**Feet for grasping** Hawks and owls, large curved claws, called talons to dig into and hold prey
Exoskeleton Hard outer covering, protection from enemies, keeps insect from drying out, waterproof	**Running feet** Two on the ostrich and three on the killdeer, all toes point forward	**Short, cone-shaped beak** Cardinals and sparrows, strong for opening seeds
Eyespots Moths often have huge eyespots on their wings to scare off predators	**Forked tongues** Snakes use it to "smell" their environment	**Long-hollow beak** Reach nectar deep inside blossoms, humming-bird
Long, fast tongues Lizards use them to zap food	**Pouch-like beak** Pelican, carrying food	**Horns** Bighorn sheep, bison Permanent, slow growing, used.for defense, mating fights
Hard shell Turtles, protects the body	**Paws with claws** Most meat eaters, to climb, dig for food or a home, hold their prey	**Whiskers** Lions, wolves, coyotes, help animal to feel the environment when going through brush or small places, especially in the dark
Hooked beak Raptors (hawks, eagles) for tearing up food	**Long pointed canines** Most meat eaters, to stab and kill prey	**Swimming feet** Ducks, aids in swimming, walking on mud

Unit 9

COMMUNITIES

OVERVIEW

In these activities students learn about plant and animal relationships in communities, how humans can change these relationships and their effects on biological diversity. Students play a community game. They turn part of their classroom into a community. At the park they participate in decision making activities and learn why we should save all the parts of a community. When they return to the classroom students decide which uses of a community are most important and evaluate possible actions humans might take as they attempt to solve a problem of coexistence with dangerous wildlife.

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TEACHER BACKGROUND

Populations of plants and animals living in the same area make up a community. The species comprising a community are interconnected in subtle ways. Making a change in a community results in a cascade of effects including changes in biological diversity or endangerment or extinction. Consider the following examples.

The large blue butterfly is extinct in Britain. It lived in grassy communities. As a result of reduction in grazing and an epidemic that reduced rabbit populations, these communities were invaded by shrubs and bushes. An ant, in whose nests blue butterfly caterpillars developed, couldn't survive these changes. The decline of the ant led to the extinction of the butterfly.

In 1970, the red-cockaded woodpecker, a resident of the southwestern United States, was officially designated an endangered species. It depends on mature, open longleaf pine communities where it constructs nest cavities in large trees. Cavity construction is a slow process, sometimes requiring more than a year. The communities red-cockadeds prefer are maintained by fire. Without fire, hardwoods become established and flying squirrels, Pileated and Red-bellied woodpeckers become more abundant and force red-cockaded woodpeckers from their homes. The exclusion of fire and current logging practices which do not leave enough old-growth pines threaten the survival of the woodpeckers.

When large predators such as pumas and jaguars are eliminated from a tropical forest community, their prey, peccary, paca and agouti, increase. They, in turn, are predators of large seeds that fall to the forest floor. The result is an decrease in large-seeded trees, a increase in small seeded plants and a change in the biological diversity of the community. The essential point is that the perpetuation of biological diversity requires the maintenance of all the parts of communities—of its natural balance. Such communities also have to be large enough so that all their species can interact with each other.

SECTION I. CLASSROOM—PRE-VISIT ACTIVITIES

Activity 1. The Community Game

OBJECTIVES

Students will be able to
1) explain what a natural community is; and
2) discuss how population increases or decreases can affect communities.

MATERIALS

For the Class
Construction paper, 2 colors
Markers
Straight pins
Large ball

For the Teacher
Blackline Master: COMMUNITIES

PROCEDURE

1. Choose a community from the COMMUNITIES blackline master.

2. Divide the class into two teams and assign each youngster a role to play. (Adjust the numbers to fit the number of children in your class by eliminating plants/animals.) Give each team enough construction paper to make name tags. (Each team should have a different color.) Have each student write what she or he is in big letters and pin them on their backs.

3. Once outside or in the gym show the class the boundaries. Mark the center. You need a large space with enough room for youngsters to run around in. It can be circular or square.

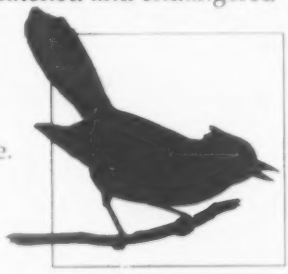
4. Challenge the teams to construct the largest and most accurate community possible in two minutes. Place teams on opposite sides of the playing area and review the rules:
- Any plant can capture sunlight. It may capture only the sunlight from the other team. When it does, the plant and sun go to the side of the playing area from which the plant came.
- Any plant can capture the raw materials. When this occurs, the plant and the raw materials go to the side of the playing area from which the plant came.
- Any animal can capture a plant or an animal it eats. When this occurs, the animal and the captured plant or animal go to the side of the playing area from which the animal came.
- Bacteria, molds and yeasts can capture any plant or animal. When this occurs, the bacteria, mold and yeast and the captured plant or animal go to the side of the playing area from which the bacteria, molds and yeasts came.
- All teams stand on their side of the playing area.

5. On your signal, members of one team try to capture members of the other team by tagging them. (Remember everyone must follow the rules.

6. Stop the game when there are no more possibilities or after the time you set. Use these kinds of questions to summarize the game:

- Does either team have a complete community? What do all communities need to be complete? (plants, animals, bacteria, molds, yeast, sunlight and raw materials) How can these organisms be grouped? (producers, consumers, decomposers)
- What are some of the raw materials that communities need? (Students will probably suggest water and air. Raw materials are the result of decomposition of dead plants and animals. The raw materials include chemicals known as soil minerals—e.g., nitrogen, sulfur and phosphorus water and gases. They are returned to communities for reuse.)

- Choose a predator from one of the communities and ask youngsters to arrange themselves in a food chain/web. Do they have enough hands to make all the connections? (For the bobcat, in the forest community these include light, raw materials, berry bushes and berries, hickory trees and nuts, oak trees and acorns, rabbits, squirrels, deer, beetles, grouse, weasels, bobcats and molds, bacteria and yeasts. Is this all of them? Do bobcats eat foxes?)
- Emphasize the idea of community interactions by asking: What would happen to the populations in this community if (name) were removed? Which populations would increase, decrease, stay about the same?
- What are some negative effects humans could have on this community? Positive effects?
- If you used the desert community this is a good opportunity to discuss threatened and endangered plants. There is a tendency to think that only animals are in trouble. Many plants are also in trouble. As of January 1989, there are 26 different kinds of cactus that are on the U.S. Fish and Wildlife Service's list of endangered and threatened plants.
- Draw a food web based on the interactions that took place during the game. Are any other interactions possible?



Activity 2. Community Day

OBJECTIVES

Students will be able to
1) trace food from producers/plants to consumers/animals (food chains and food webs); and
2) explain how plants and animals in a community depend on each other.

MATERIALS

For the Class
Paper
Art supplies: crayons, markers, colored pencils
Reference books
Scissors
Paper clips
Stapler
Thread/String
Optional:
Long piece of wrapping paper
Projector
Poster paints
Brushes

PROCEDURE

1. Students turn their classroom into a community, e.g., desert, grassland/prairie, forest, wetland, ocean or pond. If you can, introduce the work with a slide-tape, movie or video about a community/communities. See suggestions in RESOURCES (Audio Visual).

Ask the librarian to organize a supply of reference materials on the plant and animal community you choose and any of its endangered species.

Give the youngsters some research time to find out as much as they can about the plants and animals of that community, what they look like and do.

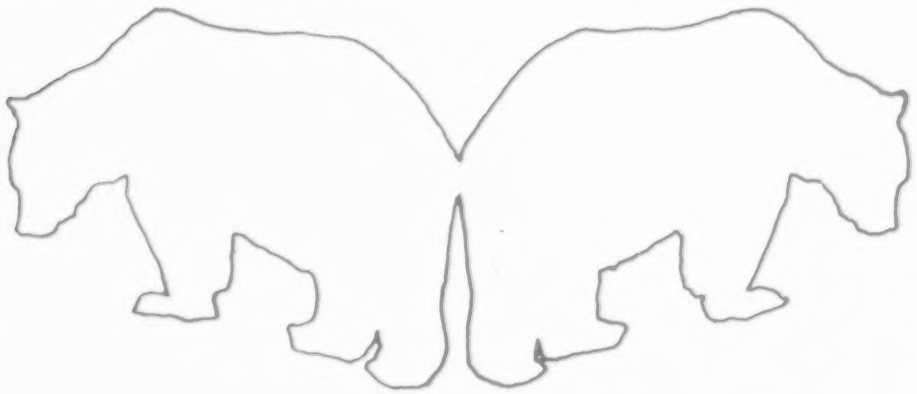
2. Students should pick out plants and animals that they would like to make. Use a sign-up sheet to ensure that both plants and animals are represented and that some aren't over-represented. If time allows, encourage students to make more than one kind of species. What you are after is a diverse and accurate representation of the community.

3. To make the plants and animals, have students draw an outline of the species they choose on a

sheet of paper. Then have them use paper clips/tape to attach a sheet of paper on the backside of the drawing so that when it is cut out, the shapes are identical. Next, fill in the details on both sides of the drawing. When finished, label the organism and staple the two sides together. Before the last one or two openings are closed, stuff the organism with crumpled paper. For stuffing, students should use the paper they remove. Preserving species diversity is helped by recycling, reusing and reducing solid waste.

4. To populate the room use thread/string to suspend the organisms from the ceiling (a three dimensional representation) or along a wall. Hang them at appropriate heights. If a wall is used add background scenery such as physical features.

5. Summarize the work by asking kids these kinds of questions:
• Can you show me some examples of producers? Consumers? Decomposers?
• What do you suppose the effect of removing (name organism) from this community would be? What would happen if the entire population of these organisms were removed?
• What are some ways that an organism might be removed from this community?
• How might this (removal) affect our lives? Is this something you care about?
• What are some ways in which this community is important? Answers will depend on the community chosen. Some examples include: helps keep soil in place; conserves water and prevents flooding; provides beauty; provides homes for plants and animals; preserves and maintains biological diversity; provides food; supplies medicines and industrial products; and opportunities for people to earn a living without destroying the community.
• We discussed (name plant or animal) that is in trouble. What are the reasons it is endangered? What are some things that are being done about it? What are some ways that people can help?
• If you visited this community you probably wouldn't see all of the species shown here. What evidence might you find of some of them?
• Give me some examples of food chains in this community. As students list them, draw a diagram on the board, e.g., oak trees, squirrels, hawks or lichens, caribou, wolves or prairie plants, seeds, mice, snakes. After you have completed a few food chains, ask whether some of them can be connected to other food chains?
• A path for hiking must be completed through this community. What do you think will happen to the plants and animals as a result? Suppose it were a freeway? A shopping center? A wilderness cabin? How could these be constructed with the least amount of harm to the community?



9-6

SECTION II. NATIONAL PARK—ON-SITE ACTIVITIES

Activity 3. The Value In Parks

OBJECTIVE
Students will be able to examine some value issues related to a park community.

MATERIALS
None

PROCEDURE
BACKGROUND
As noted in the Executive Summary of the National Park and Conservation Association's National Park System Plan (1988),

> "protecting parks 'unimpaired for future generations,' as the Organic Act mandates, requires attention to—and often intervention in—a bewildering array of forces and factors. These include biological, cultural, geophysical, and aesthetic conditions, with a host of regulatory issues accompanying them."

Park communities change after the legal delineation of park boundaries. These changes are caused by both natural events, e.g., plant succession, and by humans, e.g., the introduction of exotic species, pollutants and land use changes in the zone immediately adjacent to parks.

1. Present students with a short decision making activity related to a problem associated with a park community. This could be a change in a natural regime (e.g., fire), the introduction of an exotic, a conflict between humans and an animal, or a pollutant. Park management and research staff can provide you invaluable help. Give the class a study question (See examples below). Divide the class into several small groups and give them a few minutes to discuss the question. Summarize with a brief discussion. Below are two example issues related to the topic of communities.

A. Park status helps to protect the natural biological diversity of an area. In some Rocky Mountain parks, there are concerns about the possibility of mountain goats from adjacent habitats immigrating into the parks. Natural habitats around a park change. There are no scientific or historical records indicating that mountain goats ever lived in the area now occupied by the park.
- Ask students their opinion of the issue and the consequences of their choice?

B. Glen Canyon has a healthy population of peregrine falcons. They are an endangered species. Scientists believe that the peregrine population would grow if there were more food available. Tamarisk, an introduced plant, was never a part of the natural plant community. Some people believe that as the tamarisk population increases, that the small-bird population is increasing, providing more food for the falcons.
- Should the non-native plant be removed? Or should the increase the population of an endangered species be enouraged?

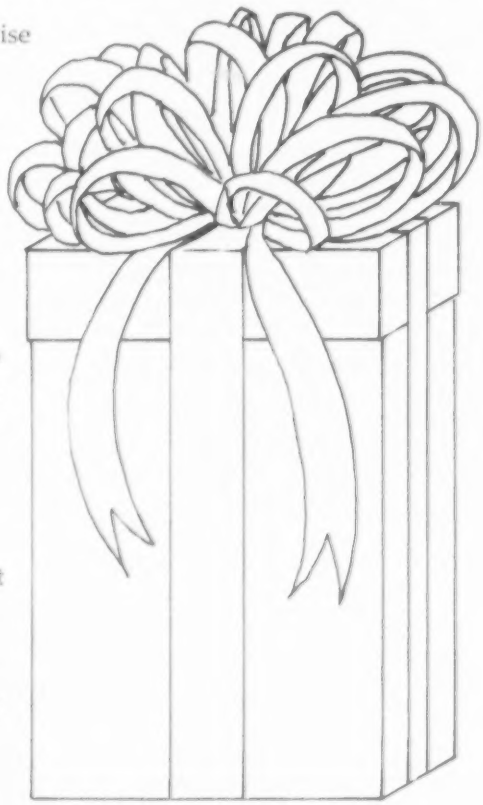
Activity 4. Intelligent Tinkering

OBJECTIVES

Students will be able to
1) understand and appreciate the value of intact communities;
2) list two kinds of foods, medicines and plants from plants/animals; and
3) describe ways that we can help promote the preservation of biological diversity.

MATERIALS

Gift box with a bow
Inside the gift box:
a. Examples of biological diversity: foods; medicines; chemicals; cosmetics; industrial products (glues, colorings, lubricants, polishes, timber, ethanol); stickers/pictures of organisms (especially of organisms for which there are no "uses")
b. Small box, beautifully wrapped with a label marked surprise



PROCEDURE

1. Carry the package or present in your backpack and at an appropriate time tell the youngsters that you have a package in your backpack that you haven't opened. It just came in the mail. Tell youngsters that you have been considering whether you should open it right away and find out what is inside.

2. Tell the kids you would like their help in deciding what to do. Pass the package around and ask what they think is in it and what you should do. If they say, don't open it, you can say that you have finally decided to open it.

3. After you open it, tell the youngsters that all of these are from communities. (Long ago, Aldo Leopold, a naturalist from Wisconsin, warned that when you take something apart it is important to save all the pieces. However, pieces of the communities, large and small, are being discarded, thrown away, sometimes all at once, as humans invade and destroy communities around the world. One scientist explained that this is like taking a package and throwing it away before looking to see what is inside. This is not something that most of us do.)

Review some of the items. Tell kids that many of our prescriptions for drugs and medicines are from wild species. Use other examples, e.g., disease resistance has to be reintroduced to agricultural crops from wild relatives every five to 15 years. This is the time it takes for plant pests to find ways to reinvade agricultural plants. Agricultural scientists are constantly on the lookout for wild relatives of

these crops. But will they be available? Wild corn from Mexico was found growing in just three tiny patches (totaling about 10 acres or 4 hectares). It is not known anywhere else in the world. Many wild wheats have disappeared. In the Middle East they are found only around ruins and in graveyards where they are protected from wild animals. Use the small beautifully wrapped gift box to talk about uses that we don't even know about. In this box there may be cures for cancer or AIDS or new ways to improve crops or control pests that are not harmful to the natural world like many manufactured chemicals.

For some of the plants and animals in both boxes there are no known uses. They are parts of communities. Some are still unknown to us (mostly insects). We don't even know they are there. Each year many new ones are found. They are all part of the natural world that Aldo Leopold told us not to throw away. If appropriate, tell kids he called this "intelligent tinkering," —saving all the pieces of a community.

4. Remind students that many communities are like presents that are unopened. We cut and burn them down and develop them before we know what is inside.

Parks are preserving as many of these presents as they can. They provide places for us to learn about the plants and animals that live in communities. They provide places for humans to learn what we have to do to live in harmony with wild communities. They provide places to preserve biological diversity. (Use any park examples you can, especially of endangered species/programs.)

Finally, emphasize the interdependence of the earth's/park's communities and our responsibility in preserving biological diversity. Invite kids to suggest ways that we can preserve biological diversity. Review potential actions with kids. These include learning more about biological diversity through educational programs, energy conservation, recycling, and learning more about products we use. If you are a Californian tell them about line 45, California State Tax form, the Rare and Endangered Species Preservation Program. Contributions are used to protect the state's 254 endangered wildlife species and their habitat.

5. Conclude by relating it back to the area (park) they are in: "The park is like an unopened present. Now we are going to open it and find out what's inside. We are also going to save all the pieces. Let's go."

SECTION III. CLASSROOM—POST-VISIT ACTIVITIES

Activity 5. Making a Choice for a Natural Community

OBJECTIVES

Students will be able to
1) decide which uses of a natural community are most important; and
2) describe the consequences of using a community for a specific purpose or purposes.

MATERIALS

For the Class
Blackline Master: 26 VOTES

PROCEDURE

1. Divide the class into five groups. Each group represents a special interest:
Group 1 - business and industry
Group 2 - city government
Group 3 - community developers
Group 4 - farmers
Group 5 - friends of biodiversity

2. Distribute copies of the blackline master, 26 VOTES, and review it. Give the groups five to ten minutes to make their selections and to decide why.

3. Have each group report their decision to the class.

4. Use these kinds of questions to summarize the activity:
• How difficult was it to decide?
• What might be the consequences of your choices?
• Would you have voted differently if you had been given 18 votes? A hundred?
• What are some things about this forest community that would be useful to know so that you could make a better decision?
• Suppose you knew some of the monetary values for some of the choices. Would that make a difference in your choice? How?
• What are the value differences between (business and industry; city government; community developers; farmers; and friends of biodiversity)? Do you trust one group more than another? Why?
• What is the best use of this forest community, first, for people; second, for biological diversity; and third, for people and biological diversity?

Ballot

Yes	No	
☐	☐	Timber for furniture, wall panels
☐	☐	Wildlife refuge
☐	☐	Harvest nuts, berries and other forest crops
☐	☐	Firewood
☐	☐	Farming-grazing cattle
☐	☐	Farming-growing crops (would have to be cleared)
☐	☐	Harvest plants for medicines and drugs for medicines
☐	☐	Tourism
☐	☐	Nature Center
☐	☐	Making your city larger, provides attractive suburb
☐	☐	Scientific research for your city college or university
☐	☐	Recreation
☐	☐	Mining for minerals
☐	☐	Building a large industrial park
☐	☐	Some birds from the north winter here
☐	☐	Park
☐	☐	Build a center, zoo and garden to help endangered species survive

Activity 6. A Community Problem in Biodiversity: The Price of Success

OBJECTIVES

Students will be able to
1) describe direct competition between human and other species use of natural communities; and
2) evaluate proposed solutions to human-species conflicts.

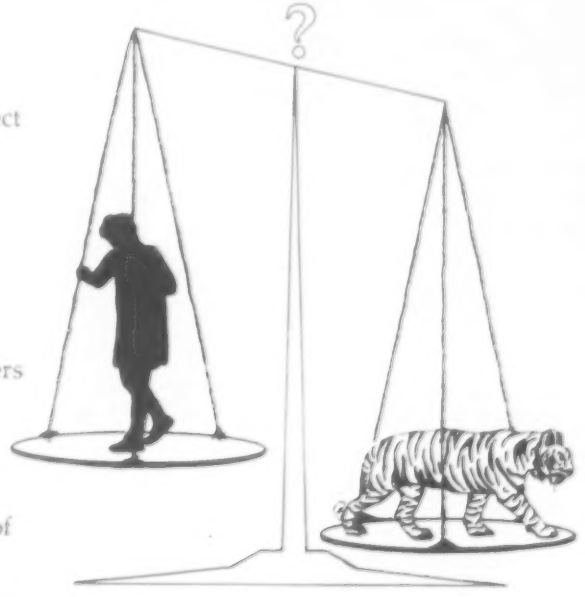
MATERIALS

For the Class
Blackline Master: PROJECT TIGER

PROCEDURE

1. Distribute copies of PROJECT TIGER and read it with your class. (There is an excellent and well-illustrated article by Geoffrey Ward in Smithsonian, November 1987, on the tiger problem.)

2. Divide your class into small groups. Write this question on the board: What are your ideas about what should be done? Remind students that the park does not really benefit the villagers. What are some things that the government should do to help people who have relied on parks for all their lives for wood for fuels, home construction, feeding their animals, food and income from collecting honey?



3. Discuss the work and encourage students to reflect on their beliefs.
- What assumptions are being made?
- What are some of the consequences of proposed actions for tigers, the government, the human and natural communities involved, etc?
- Is this something we in the U.S. should be concerned about?
- What if the only answer is to keep people and tigers apart—to declare the reserves and a wide zone around it off-limits to humans? Is this possible? What would you provide for all the people who would have to move? How would you help them understand that there is no choice? Can you think of some ways to help them understand that their lives and healthy forest communities are interconnected, that you can't have a good life without a healthy environment?
- Based on our discussion, do you have any new ideas about biological diversity?

EXTENSION

1. There are numerous opportunities for these kinds of decision making activities. To localize them, present students with a photograph, an article, a story you have written, or a news item. Develop a study question/questions and have youngsters examine the data, then discuss it with them in a reflective fashion.

EVALUATION

1. You are visiting a friend who points out a lovely clump of spring flowers in the backyard. You ask what they are and where they are from. Your friend doesn't know but replies that she helped her family dig them up from the woods last spring. Later you discover that these plants are an endangered species. What would you do?
- Tell your friend and ask her to talk to her parents about it.
- Offer to help you friend return the plant to the wild.
- Talk to her parents about it.
- Call the natural resources department to find out what you should do.
- Explain the facts of communities to her.
- Other _____
- What is the reason for your choice?

2. Draw a picture of a food chain and label it.

3. Draw a picture or diagram of a natural community and label.

4. How is a natural community similar to a human community? How is it different?

5. Which of these communities can exist? Explain your answer.

a. Sunlight, producers, consumers (plant eaters), decomposers, raw materials

b. Sunlight, consumers (animal eaters), decomposers, raw materials

c. Sunlight, producers, decomposers, raw materials

RESOURCES

AUDIO-VISUAL

Agency for Instructional Technology, Box A, Bloomington, IN 47402. (Video: *Marsh and Swamp, The Pond, Where Plants and Animals Live, In the Field, Interdependence of Living Things, The Natural Balance*).

National Geographic Society, Educational Services, Department 88, Washington, DC 20036. (Filmstrips: *Exploring Ecology, The Woodland, Places Where Plants and Animals Live*).

CLASSROOM

Caroline Arnold. 1985. *Saving the Peregrine Falcon*. Carolrhoda Nature Watch Series, Carolrhoda, Minneapolis, MN.

Jeffrey J. W. Baker. 1967. *Patterns of Nature*. Doubleday, New York, NY.

Anita Malnig. 1985. *Where the Waves Break: Life at the Edge of the Sea*. Carolrhoda, Minneapolis, MN.

J. J. McCoy. 1966. *Hunt for the Whooping Cranes: A Natural History Detective Story*. Lothrup, Lee and Shepard, New York.

James Newton. 1980. *Forest Log*. Thomas Y. Crowell, New York, NY. (For lower grades, but beautiful introduction to the biological community concept.)

Joyce Pope. 1978. *A Closer Look at Jungles*. Gloucester Press, New York, NY. St. Regis. 1969. The Life of the Forest. St. Regis Paper Company, Stamford, CT.

GENERAL

David R. Wallace. 1987. *Life in the Balance: Companion to the Audubon Television Specials*. Harcourt, Brace and Jovanovich, San Diego, CA.

Geoffrey C. Ward. 1987. *India's Intensifying Dilemma: Can Tigers and People Coexist?* Smithsonian, November, pp. 53-65.

World Wildlife Fund. *The Importance of Biological Diversity: A Statement by WWF-World Wide Fund for Nature*. WWF-United States, 1250 24th Street N.W., Washington, DC 20037.

COMMUNITIES

POND COMMUNITY

2 Sunlight
2 Raw Materials
2 Bacteria, Molds, Yeasts
3 Algae
2 Mayflies
2 Daphnia
2 Cattails
3 Pond Weeds
2 Muskrats
2 Water Beetles
2 Sunfish
2 Turtles
2 Frogs
2 Mink

DESERT COMMUNITY

2 Sunlight
2 Raw Materials
2 Bacteria, Molds, Yeasts
3 Saguaro Cactus
3 Prickly Pear Cactus
2 Ocotillo
2 Jack Rabbits
2 Pack Rats
2 Desert Iguanas
2 Grasshoppers
2 Sidewinders
2 Scorpions
2 Roadrunners
2 Owls

GRASSLAND COMMUNITY

2 Sunlight
2 Raw Materials
2 Bacteria, Molds, Yeasts
3 Big Bluestems
3 Goldenrods
2 Compass Plants
2 Grasshoppers
2 Pocket Gophers
2 Jack Rabbits
2 Field Crickets
2 Hawks
2 Snakes
2 Badgers
2 Owls

FOREST COMMUNITY

2 Sunlight
2 Raw Materials
2 Bacteria, Molds, Yeasts
3 Berry Bushes
3 Hickory Trees
2 Oak Trees
2 Deer
2 Rabbits
2 Squirrels
2 Beetles
2 Grouse
2 Foxes
2 Weasels
2 Bobcats

26 VOTES

NAME:_____

The community in which you live has been given a large, forested community. Not much is known about it. The landowner made one request: the forest community is to be used "in the best interests of the citizens." You have twenty-six (26) votes to spend on the following list. There is no rule saying just how many uses to vote for. There is no rule saying just how many votes you should give a particular item. This is up to you. The only rule is that the total number of votes must equal 26. Write the number of your votes in the space provided.

☐ 1. Timber for furniture, wall panels
☐ 2. Wildlife refuge
☐ 3. Harvest nuts, berries and other forest crops
☐ 4. Firewood
☐ 5. Farming-grazing cattle
☐ 6. Farming-growing crops (would have to be cleared)
☐ 7. Harvest plants for medicines and drugs for medicines
☐ 8. Tourism
☐ 9. Nature Center
☐ 10. Making your city larger, provides attractive suburb
☐ 11. Scientific research for your city college or university
☐ 12. Recreation
☐ 13. Mining for minerals
☐ 14. Building a large industrial park
☐ 15. Some birds from the north winter here
☐ 16. Park
☐ 17. Build a center, zoo and garden to help endangered species survive
☐ 18. Other: _____
(name)

Tigers are an endangered species. In 1973 there were only 1,800 tigers in India. There was concern that they would become extinct. Project Tiger set out to save them. Now there are 4,000. Project Tiger has been very successful but there has been another result. More than 50 people a year are killed by tigers. Most of these are a case of mistaken identity. Tigers tend to avoid humans on foot. Even if a person gets too close, they give a warning roar or two. The second roar is even louder. If this doesn't work tigers may then give a false charge. Most often they just turn tail and run.

But humans bend over to cut grasses, collect firewood and food. To tigers they look like browsing deer. Humans wander off trails and roads. They sit in boats as they fish. They farm right up to the forest edge. Their livestock wander into the reserves and are killed. The number of villages surrounding tiger reserves is also increasing. They need wood for cooking, materials for housing, food for themselves and their cattle. Tigers are becoming very familiar with humans and regard them as prey.

To save the tigers, villagers have been moved from their forest homes. The forest has produced almost all their needs for centuries. Even though the government provides land and money to help them move, the villagers think the government cares more about tigers than them. They are afraid to leave their homes at night. The government pays villagers a small amount for losses—$155 for livestock and $770 to the family of a person killed by a tiger. Now, in many places the villagers are poisoning tigers.

Can tigers be trained to behave? Dummies that smell and look like people give tigers a powerful shock when they are attacked. Fishermen wear human masks on the backs of their heads because tigers seldom attack humans from the front. Project Tiger is looking for ideas that meet the needs of villagers and tigers.

Unit 10

BIODIVERSITY AT HISTORIC AND CULTURAL SITES

OVERVIEW

Culture and nature are intimately interconnected. In these activities youngsters make a biological diversity booklet on the variety of ways early people used plants and animals. They make a time line that includes historical and biological diversity events. At a cultural site, they explore uses and abuses of biological diversity. Back in the classroom they study the symbols of biodiversity chosen by their state.

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TEACHER BACKGROUND

One of the earliest calls for the establishment of national parks focused attention on the connection between biological diversity and culture. In 1832 artist and naturalist George Catlin recommended as a result of his close study of the American Indian that vast regions protecting the Indian way of life and the ecology (especially the buffalo) on which it depended should be set aside as a "magnificent park" by "some great protecting policy of government."

Recently there has been renewed interest in culture and efforts to preserve biological diversity worldwide. The establishment of nature preserves to protect biological diversity must take into account neighboring peoples. Preservation of natural areas must also improve the quality of life for local human populations or the protected areas are not likely to survive the pressure of people who depend heavily on plants and wildlife for medicines, food, fuel for cooking and heating, clothing, sources of revenue and spiritual or religious objects.

One of the major programs is Biosphere Reserves, a global network of protected areas operated by UNESCO's Man and the Biosphere Program (UNESCO-MAB). There are three zones of activity in biosphere reserves:

Core Area
This is the zone of maximum protection. Its purpose is to preserve biological diversity and to obtain scientific information. Its uses are limited to research and education. It is a conservation unit, e.g., a natural park, preserve, or wilderness area.

Buffer Zone
This area insulates the core area. It can be managed and used for training and education. Humans can use it for traditional uses so long as it harmonizes with the environment.

Multiple-Use Area
This area is used for human activities including settlements, forestry, farming, grazing. These categories are flexible.

The first biosphere reserves were designated in 1976. As of March 1988 there are 269 reserves in 70 countries including 43 in the United States. While all parks have cultural, historical, and social dimensions, some are dominated by such themes. Robert Sanford suggests that cultural and historic sites can contribute to an understanding of biological diversity in three ways:
1) They promote cultural identification with the environmental system by showing humans can be viewed and understood as part of a larger ecological complex.
2) Through study of the interactions, they show the historic continuity of human—non-human as a part of a whole.
3) They can demonstrate lessons about human-environmental interactions.

SECTION I. CLASSROOM—PRE-VISIT ACTIVITIES

Activity 1. Biological Diversity Booklets

OBJECTIVE
Students will be able to describe how ancient people relied on and used biological diversity.

MATERIALS
Art materials
Construction paper
Stapler/staples

PROCEDURE
1. A week before you initiate this activity, describe the project to your librarian/media center person. Ask for help in locating books and other resources which students can use to research their topics.

2. Divide your class into six small groups. Each group will prepare a biological diversity booklet on how early people relied on biological diversity. You may want to assign geographic areas of the United States, e.g., Northeast, Southeast, North Central, South Central, Northwest and Southwest. Some examples of uses of biological diversity include food, clothing, shelter, utensils (horns of buffalos for cups), weapons, tools, medicines, dyes, transportation (buffalo hides for canoes), and spiritual ceremonies. Each student will prepare four pages of the regional booklet.

Students should label the front outside of a folded piece of paper with the name of the plant or animal; the first inside page is for a drawing of the way it is used; the second inside page is for a description, with as many facts as possible, about the plant or animal; and the back outside page is for a drawing of the plant or animal. Each group is to make a cover with a title, the authors, and a table of contents. The completed booklets can be stapled together along the folded edges.

3. Have each group make a presentation on their work and put the booklets on display. These minibooks can be shared with other classes, too.

4. Use these kinds of questions to lead a class discussion:
- What are some of the ways that plants and animals were used by early people?
- How were different communities similar in their reliance on biological diversity? Different?
- Are any of the plants still being used today? How?
- Are any of the animals are still being used today?
- Do we depend on plants and animals more, less or about the same as early people did? Why?
- (To be used if you studied Indian uses of biological diversity.) Our work has shown that Indians relied on biological diversity in a great variety of ways. However, extinction and threats of extinction to plants and animals was not a problem. Today it is. What are the reasons for this difference? Can we take some lessons today from the relationship between Indians and the natural world?

Activity 2. Getting a Line on Biodiversity and History

OBJECTIVES

Students will be able to
1) describe organisms that have become extinct since Europeans came to the United States; and
2) will be able to explain some reasons for their extinction.

MATERIALS

Butcher paper
Scissors Yarn/String
Tape Markers/Crayons
Reference
Books
Blackline Masters:
BIODIVERSITY EVENTS
NORTH AMERICAN EXTINCTION EVENTS

PROCEDURE

1. Draw a straight line on a strip of paper long enough to go from one end of the room to the other and post it on the wall or stretch a piece of string or yarn from one end of the room to the other.

2. To start the activity, describe the time line. Tell students that one end is the beginning and the other is the present in the life of the United States. Label the present with the year. The events placed on time lines are all the things we can think of that have been important. Ask students what event/date they would use to indicate the beginning. When you have reached agreement indicate that date and divide the line accordingly. You can make the time line site specific, i.e., for Lincoln's home use the time period from Lincoln's birth to his death. Use the historical and biological diversity events (pp. 15 - 19) that took place during this period.

3. Divide the class into teams of three. Ask them to choose one important event in U.S. history. Students should write the name and date of the event with a marker/crayon on a sheet of paper. Have students attach a piece of yarn to the paper and use a piece of tape to hang their historical marker on the time line.

4. Review the events with the class. Have we missed any important ones? When did our state become a state? When was our town founded/incorporated? Should we include the date the nearest national park became a park?

5. Now tell kids that they are going to add some historical events that are generally left out of history books and lessons—biological diversity events. These include extinction events, threats to and events associated with the protection of animals and plants. Give each team a copy of NORTH AMERICAN EXTINCTION EVENTS. Emphasize that these are not all the U.S./North American extinction events, known or unknown. In general, the extinction dates are not exact. There have been more extinctions than we know. Only one plant is listed. The Center for Plant Conservation estimates that 200 kinds of U.S. plants are already extinct, e.g., Cook's kokia. Each team will choose one extinct animal or plant to add to the time line. Have them research their organism to find out why it became extinct, and to draw a picture of it. Each team will add its report to the time line.

It is strongly suggested that you begin developing a library of resources for youngsters to use. This includes books/pamphlets from state and federal agencies and clippings/articles. The book by David Day (See RESOURCES) is highly recommended and is relatively inexpensive.

6. Use these kinds of questions to discuss the time line:
- What are some things you notice about the time line?
- How does the present compare with the beginning of the time line?
- Can you explain the differences between the beginning and end of the time line?
- When you grow up, do you think the number of extinctions will increase, decrease, or stay about the same? How might this affect our lives? The lives of other kinds of animals and plants?
- If we were to develop an extinction time line for the rest of the world would it look about the same as ours? Why or why not?
- When you grow up do you think there will be more, less, or about the same number of laws and regulations to protect plants and animals? How might this affect our lives?
- What are some things that have been done to protect species? Are any listed on the time line? What are some ways that they help species in trouble?

7. Leave this time line in place during your study of biodiversity in U.S. history and culture.

SECTION II: NATIONAL PARK—ON-SITE ACTIVITIES

Activity 3. Biodiversity in History - Part I

OBJECTIVE

Students will be able to describe two relationships between the biological diversity and the human history of an area.

MATERIALS

Containers/objects (See PROCEDURE)

PROCEDURE

1. Prepare several containers with different objects inside. Place them in appropriate places and use them at appropriate times. The objects should be from a natural source but relate to the cultural history of your park area. Some examples are:.

- silhouettes of animals that used to be on the site, e.g., bison, antelope, cattle;
- skulls, bones (the teeth of a pest, e.g., prairie dog), owl pellets;
- plant or animal materials used by Native Americans (A marvelous museum label from Freeman Tilden's *Interpreting Our Heritage* comes to mind. "Do you need a water bucket? A pair of shoes? A blanket, floor mat or rope? If so, the materials in this case (sotol, lechuguilla, beargrass, devil's shoestring, etc.) will serve your purpose.");
- matches (if fire is used to manage vegetation);
- a report, e.g., a report from Wilson's Creek National Battlefield, MS, indicates that the soldiers marched through a parklike forest, typical of mature oak-hickory forest or savanna. This community is not found anywhere in the vicinity today;
- a diary from Fort Laramie National Historic Site, WY, notes that by 1845, the grasslands had deteriorated to the point that animals had to be moved three miles (five km) from the fort. In the next few years the community around the fort was covered with prickly pear (*Opuntia* spp.) In the early 1850s, large herds of bison passed near Fort Laramie. As the grasslands deteriorated, the bison stopped coming. The U.S. Army required horses and mules for transportation and cattle were required for food. However, the animals required pasture. There were thousands of immigrants passing through, too, adding to the overgrazing problem. In 1852, an order was issued limiting the number of animals owned by enlisted men, in order to conserve some of the grasslands. If you can, get a copy of this kind of order or notes about such issues, use them;
- farm implements;
- exotic weeds;
- a photograph of *then* with a comparison of *now*, e.g., historically, grazing and fire were important influences on prairie vegetation. When fire is stopped, the prairie undergoes ecological succession. Prescribed burning is used to restore and maintain vegetation. In other areas the vegetation was much influenced by domestic grazing animals. The restoration of the original vegetation may include prescribed burning, reseeding and other techniques. Children might be asked to interpret a rough map/pictures showing these events;

• use of a biological control agent for a pest, e.g., spurge hawkmoth for leafy spurge; and
• rubber/energy plants. Thomas Edison examined 2,000 U.S. plant species as sources of natural rubber. Only one was useful: guayle. He and others since have discovered a number of potential fuel oil producing plants, e.g., members of the milkweed family, silver maple, smooth sumac, tall bellflower, common elderberry, coralberry, giant ragweed, field thistle, tall boneset, rosinweed, compass plant, prairie dock, sow thistle, ironweed, lechillo, mole plant, sassafras, pokeweed, New Jersey tea, wild plum and tumbleweed.

2. At appropriate places and times open the containers. Explain that inside is something about biological diversity and history/culture. Depending on what you say about the object and the historical/cultural context, you can ask kids to guess what the object is and what it is/was used for.

Activity 4. Biodiversity In History - Part II

OBJECTIVE

Students will be able to describe two relationships between the biological diversity and the human history of an area.

MATERIALS

Bags, cloth
Objects (see PROCEDURE)

PROCEDURE

1. Place objects such as fur, seeds, herbs, plant parts, in bags.

2. Hang/place the cloth bags in appropriate places. Pause and have kids smell or reach in and touch or, if appropriate and safe, taste. Then ask them what they think it is or how it was used in the natural world.

3. Briefly discuss these items in terms of biological diversity and history. The bag's contents may be about nature's medicine cabinet or an agricultural product. It may be uses Native Americans found for these objects. It may be something still used. It may be about collecting and using seeds in revegetation projects or an economic botany lesson about biodiversity, e.g., all of the wild relatives of cultivated squashes and pumpkins contain bitter substances. Long ago Indians discovered some squashes that were less bitter (sweeter tasting) and that resulted in plants so commonplace,that we can't imagine life without them. Thanks to biodiversity!

Activity 5. Biological Diversity Interpretation At Cultural Sites: A List of Ideas From Interpreters

OBJECTIVES

Students will be able to
1) describe a change made by humans and an affect on biological diversity; and
2) discuss relationships between humans and biological diversity.

MATERIALS

See PROCEDURE

PROCEDURE

These are activity ideas from interpreters—starters, kernels of ideas, all requiring embellishment. Our deep concern about biological diversity is quite recent. Biological diversity specifically has not been a major focus of either park interpretation or environmental education in the past.

Each year or decade a new metaphorical lens or prism is suggested as "the" way to see the world. As a lens, biological diversity can be as convergent, divergent and magnifying as you want. Hopefully, enthusiasm for biological diversity will not go away. It is a unifying idea where humans and nature meet and is at once about energy, air, water, history, past, present, futures, global interdependence, agriculture, values, culture, economics, government, politics, and ethics. It offers endless opportunities for interpretation, environmental education and for humans to examine their role and place on the planet.

SNAKES, BATS & RATS
Comparison of species adapted to urban settings with those adapted to wildlands.

A WORLD UNDER MY FEET
Examination of the diversity that exists within the microcosm of plants and animals found in a cubic foot of lawn or soil.

BUTTERFLIES IN MY GARDEN
Examination of how appropriate plantings of trees, shrubs, flowers, and grasses in urban environs can attract and provide habitat for a multitude of wildlife.

THEN, NOW
If the cultural unit has evidence of landscape changes (most do), you can relate that nicely to changes in diversity, e.g., what may have lived here when this was a field at the time of the battle? Now that it is an oak-hickory forest, what is here? What is your evidence? Do you think diversity is up or down and why?

EDGES

Talk about edges—If you have a clearing in the forest for a fort or homestead, there are more species (probably) near the edges. Why? Run a vegetation transect line—just a 100 meter tape—and count how many plants you cross (different plants). Put cans out for drop traps in various places. Put boards with sand or flour out on the night before the visit in various places for tracks.

HUMAN IMPACTS

How do changes in environment due to human impacts affect biological diversity, e.g., dunes at Cape Hatteras, clearing areas for farming, construction of roadways and resultant trash and litter ?

DESIRABLES—UNDESIRABLES

How species change from *desirable* species (bunnies, deer, hawks, songbirds, wildflowers) to *undesirables* (rats, pigeons, starlings, dandelions) in an area as it becomes urbanized.

COMPARING...CONTRASTING

Compare and contrast species known to have occupied an area 100-150 years ago to present day inhabitants. What caused the decline? What has been the impact on the area, if any? Could these organisms be reintroduced?

SECTION III. CLASSROOM—POST-VISIT ACTIVITIES

Activity 6. State Biodiversity Symbols

OBJECTIVES

Students will be able to
1) identify state plants and animals;
2) discuss how they were chosen; and
3) assess their position with regard to the value issues that are imbedded in such uses of plants and animals.

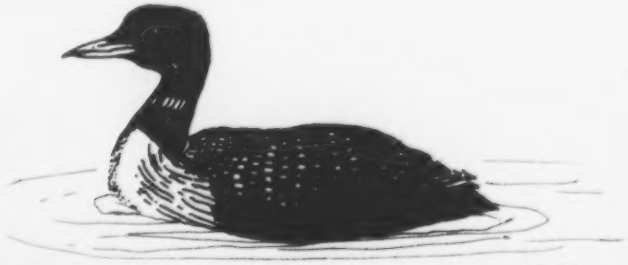
MATERIALS

Blackline Master:
SYMBOLS OF BIOLOGICAL DIVERSITY

PROCEDURE

1. Divide your class into small groups and have each group research its state's use of biological diversity in state symbols. Distribute copies of the blackline master, SYMBOLS OF BIOLOGICAL DIVERSITY. Do you have a state fish, flower, mammal, tree, bird, fungus, grain, muffin, etc? If necessary, give groups time to write a letter to the information offices of the state legislature and state conservation agencies to learn more about details. Some official state highway maps contain information about the organisms. For the legislature these are typical questions that can be asked: When was the bill first introduced? Who introduced it? Were other species considered? What are the reasons this species was selected? Was the bill passed the first time it was introduced? Has there ever been a bill introduced for a state _____?

For state conservation agencies these are the kinds of questions that can be asked about the species: Where is it found? Are there any special concerns about it? If so, what are they and how is it being protected? How large is the population? Is it migratory? If so, does this present any special problems? How was it used by Native Americans? (Your state historical society can also help here.) Are there any other laws/ regulations that have been passed related to this species? How common is it in the U.S.? Before this country was settled by Europeans, was this species more or less common than it is now, or was it about as common as it is now?



2. Have students make a report on their findings.

3. Summarize the investigation by asking these kinds of questions:

- What are some reasons that plants and animals are used as state symbols?
- Are there any ways in which these symbols affect our lives? How could they be made to affect our lives?
- Illinois school children have selected a state fish (the bluegill), a state tree (white oak), and a state animal (white-tailed deer). The bluegill was named the state fish over five other candidates: carp, channel catfish, coho salmon, largemouth bass and the white crappie. What is your opinion of this selection procedure? What do you see as its major weaknesses and strengths?
- Do you think we need any additional state symbols? Which ones? Should we have a state frog? Snake? Insect? What are your reasons?
- If a state species is also a migratory species, e.g., it leaves the state for the winter, what would you like people to know about it in the place where it winters?
- What do you think of the idea to have state plants and animals? What can you say in defense of your view?
- In 1983, 4th graders in Saco and Kennebunk, ME, agreed that the state's license plate should depict a lobster. They collected 11,000 signatures from residents of 140 towns on a petition supporting their idea. It took four years before lawmakers approved the students' design. Objections were raised from residents who lived inland, growers of potatoes and blueberries, lovers of forests and animals rights activists who objected to a red lobster, indicating that it had been cooked. What do you suppose would be the effect of animal/plant license plates on making people aware of biological diversity? Would this be good? Do you think that when the state uses such symbols people's awareness of biological diversity increases or decreases? Or does it stay just about the same? What might be some other things we could do to use such symbols to teach people about biological diversity?

EVALUATION

1. Benjamin Franklin wanted the wild turkey to be our national symbol. Instead the bald eagle was chosen. What are two things that each symbolizes?

2. What are two ways that learning about biological diversity and history might affect people's attitudes toward biological diversity?

3. Give an example of two changes in biodiversity that have occurred in the last 100 years.

4. What are three ways we use biological diversity today that are similar to the ways it was used in earlier times?

5. What are three ways we use biological diversity today that are different from the ways it was used in earlier times?

6. Name an event in the history of biological diversity and tell how biological diversity has been affected since then.

RESOURCES

CLASSROOM

David Day. 1981. *The Doomsday Book of Animals: An illustrated account of the fascinating creatures which the world will never see again.* The Viking Press, New York.

Greta Nilsson. 1986. *The Endangered Species Handbook.* (Free to educators. Animal Welfare Institute, P.O. Box 2650, Washington, DC 20007)

Official Birds, Mammals, Trees, Flowers, Insects, and Fish of the United States, Territories and Possessions. Single copy free. National Wildlife Federation, 1412 Sixteenth Street, N.W., Washington, DC 20036.

Robert Silverberg. 1967. *The Auk, the Dodo and the Oryx: Vanished and Vanishing Creatures.* Crowell, New York.

Whales of the World: An Educational Program. International Wildlife Coalition, Whale Adoption Project, 320 Gifford Street, Falmouth, MA 02540.

Zoobooks. A series about animals, including endangered animals, accompanied by teaching materials. Wildlife Education Limited, #930 W. Washington Street, Suite 14, San Diego, CA 92103.

GENERAL

Lee Durrell. 1986. *State of the Ark.* Doubleday, New York.

Allen Eckert. 1963. *The Great Auk.* Little, Brown, Boston, MA.

Paul A. Opler. 1977. *The Parade of Passing Species: A Survey of Extinctions in the U.S.* The Science Teacher, January.

Robert M. Sanford. 1986. Cultural resources and a sustainable future in John F. Disinger and John Opie (eds) *Environmental Education: Progress Toward a Sustainable Future.* North American Association for Environmental Education.

U.S. Fish and Wildlife Service. 1987. *Restoring America's Wildlife.* U.S. Government Printing Office, Washington, DC.

U.S. Fish and Wildlife Service, Office of Endangered Species, Washington, DC 20240. (Brochure, pamphlets, on endangered species and laws/regulations.)

BIODIVERSITY EVENTS

1782. Bald eagle, national symbol of the U.S.
1813. A report of a single flock of passenger pigeons, 240 miles long, a mile wide, consisting of 2 billion birds.
1825. Buffalo extinct east of the Mississippi.
1839. On the Sante Fe Trail, it took Thomas Farham three days to ride through part of a single buffalo herd. The area was about the size of Rhode Island. More than one million animals.
1853. House sparrows from England released in Brooklyn, NY; became permanent residents.
1864. *Man and Nature* by George Perkins Marsh, a U.S. Congressman and ambassador. This book made people aware of the effects of humans on the balance of nature.
1867. Alaska purchased from Russia.
1869. Gypsy moth introduced from Europe to Massachusetts to develop a "new and improved" silk-producing caterpillar. Escaped from lab.
1870s. Official U.S. government policy to kill buffalo in large numbers in order to defeat the Indians.
1871. Wyatt Earp. "I could see twenty or thirty miles in each direction. ... The prairie appeared to be covered by a mass of huge, furry heads and humps, flowing along like a great muddy river...." These were buffalo; about one million of them.
1872. First Arbor Day celebration, April 10, Nebraska.
1872. Yellowstone National Park established.
1874. Over a four week period, 25,000 passenger pigeons a day shipped to market.
1875. President Grant vetoes a bill to restrict the hunting of buffalo.
1878. Hunters destroy 2 million passenger pigeons near Petowsky, Michigan.
1883. Brown trout from Europe introduced to North American streams.
1888. Ladybug beetle brought to California from Australia to control a plant fungus.
1889. Hunting of buffalo stopped. Last roundup held and 89 buffalo were gathered; about 1000 more in Yellowstone National Park or a Canadian national park. It is estimated that there was once a population of 60 million buffalo.
1890. Starlings from Europe released in New York City; became permanent residents.
1892. First wildlife refuge, Afognak Forest and Fish Culture Reserve, Alaska. President Benjamin Harrison signed this order.
1894. Law passed protecting wildlife in Yellowstone National Park.
1903. Pelican Island Reserve, Florida. First U.S. wildlife reserve. President Theodore Roosevelt.
1904. Chestnut blight arrived on young trees from the Orient; within 40 years nearly all chestnut trees were dead.
1913. Weeks-McLean Act. Migratory birds protected by federal government.
1916. National Park Service established to administer national park areas.
1918. Migratory Bird Treaty Act between Canada and U.S. Regulations and penalties for possessing, shooting, selling, transporting and importing migratory birds.
1920. European wild hogs escaped from a game preserve in North Carolina; became permanent residents.
1920s. Lamprey invaded the Great Lakes through shipping canals; decimated lake trout and whitefish populations.
1927. Gray wolves eliminated from Yellowstone National Park.
1929. Migratory Bird Conservation Act. Provided refuges for birds during migration.
1932. The number of trumpeter swans in the lower 48 states is sixty-nine.

1937. Aransas National Wildlife Refuge, Texas, created to protect whooping cranes.

1937. Federal Aid in Wildlife Restoration or Pittman-Robertson (P-R) program. A tax on hunting equipment. The money is used by states to purchase and manage habitat and conduct wildlife research.

1940. Bald Eagle Protection Act passed; made it illegal to sell, barter, transport, export, import, or shoot bald eagles.

1941. Fifteen whooping cranes left, winter home in Texas.

1954. Discovery of summer home of whooping cranes, Wood Buffalo National Park, Canada.

1950s. First learned that lead poisoning (from shotguns) causes the deaths of many thousands of ducks and geese each year.

1950s. Gypsy moths found in New York State.

1966. Fur Seal Act passed, protecting seals.

1969. About 1200 nesting pairs of bald eagles in the 48 states; 115 nesting pairs in Minnesota.

1970. Man and the Biosphere (MAB), a United Nations program designed to show how people and the natural world can live with one another. There are more than 40 U.S. National Parks in this program and some of them are: Yellowstone National Park, Everglades National Park, Great Smoky Mountains National Park and Haleakala National Park.

1970s. Gypsy moths found in Pennsylvania, Georgia, Missouri, Minnesota, Wisconsin.

1970s. Winter home of monarch butterflies discovered in Mexico. More than 200 million individuals. These butterflies re-populate the entire eastern U.S. each spring. Wintering sites are threatened by timber cutting.

1972. DDT, a pesticide, banned in the U.S. Caused egg shells of many birds, especially eagles and hawks, to thin and shatter when sat on.

1972. Marine Mammal Protection Act. Marine animals in U.S. waters cannot be bothered, hunted, captured or killed.

1973. Endangered Species Act, determines which species are in danger of extinction.

1975. A captive flock of whooping cranes in Maryland began laying eggs and raising young.

1975. A second wild whooping crane flock was established at Gray's Lake National Wildlife Refuge, Idaho, from eggs collected in Canada. Sandhill cranes act as foster parents.

1977. Convention on the International Trade in Endangered Species (CITES), regulates trade for protected plants and animals.

1981. In the eastern U.S., more than 1 million acres of trees and shrubs lose leaves (defoliation) because of gypsy moths.

1981. Lacey Act; protects fish, wildlife and rare plants from illegal collection.

1981. Tecopa pupfish, Death Valley, extinct.

1981. Whooping cranes increased to more than 100.

1983. *Sisquoc*, the first California condor ever hatched in captivity, March 30, San Diego Zoo.

1985. Ruffe invade Lake Superior as stowaways in the ballast tanks of ocean going vessels; can drastically reduce perch or whitefish population.

1986. International treaty bans whale hunting. Japan, Iceland and Norway continue to hunt whales.

1986. Total number of trumpeter swans in the 48 states has increased to several hundred.

1986. In the eastern U.S., gypsy moths defoliate approximately 2.5 million acres of trees and shrubs.

1987. The beginning of the change from lead to steel shot for hunting. It will be completed in 1992. Lead shot poisons ducks and other aquatic life.

1989. 2,200 nesting pairs of bald eagles in the lower 48 states; up from 500 pairs in the early 1960s; there are 372 nesting pairs in Minnesota.

1989. Dusky seaside sparrow, Florida, extinct.

NORTH AMERICAN EXTINCTION EVENTS

MUSSELS		
Fine-rayed Pearly Mussel	1800s	Ohio River
Nearby Pearly Mussel	1910s	Tennessee
Recovery Pearly Mussel	1954	Georgia
Arc-form Pearly Mussel	1940s	Tennessee
Sampson's Pearly Mussel	1910s	Illinois
SNAILS		
Alabama River Snail	1924	
Alabama Live Bearing Snail	1957	
North Carolina Magnificent Snail	1947	
Alabama Magnificent Snail	1957	
Texas Magnificent Snail	1947	
CRUSTACEANS		
Hay's Spring Scud	1957	District of Columbia
Pasadena Freshwater Shrimp	1933	California
Sooty Crayfish	1860s	California
INSECTS		
Florida Atala Butterfly	1963	Florida
Texas Blue Tailed Butterfly	1926	Texas
Xerces Blue Butterfly	1943	California
Unsilvered Fritillary Butterfly	1959	California
Strohbeen's Parnassian Butterfly	1958	California
Silverspot Butterfly	1932	New Mexico
Sthenele Wood Nymph Butterfly	1890s	California
FISH		
Tecopa pupfish	1982	California
Longjaw cisco	1983	
Blue pike	1983	Utah
Lake Sculpin	1930s	Utah
Pahranagat Spinedace	1950	Nevada
Pahrump Ranch Killifish	1955	Nevada
Raycroft Ranch Killifish	1955	Nevada
Miller Lake Lamprey	1950	Oregon
Smoky Madtom	1957	Tennessee
Clear Lake Minnow	1940	California
Big Spring Spinedace	1950	Nevada
Whiteline Topminnow	1899	Tennessee
June Sucker	1934	Utah
Spring Valley Sucker	1950	Nevada
Thicktail Chub	1950	California
Harelip Sucker	1893	Mississippi Drainage
Shortnose Sucker	1960	Oregon
Ash Meadow Killifish	1942	Nevada
Blackfin Cisco	1955	Great Lakes
AMPHIBIANS		
Vegas Valley Leopard Frog	1938	Nevada
BIRDS		
Santa Barbara Song Sparrow	1983	California
Carolina Parakeet	1901	Southeast
Painted Vulture	1800	Florida
Eskimo Curlew	1970	North and South America
Great Auk*	June 3, 1844	Eldey Island

* Jon Brandsson and Sigourer Isleffson killed the last two adult birds with clubs. Ketil Ketilsson smashed the egg with his boot.

Passenger Pigeon	Sept. 1, 1914 1 p.m.	Cincinnati, Ohio
Heath-hen	1932	Atlantic Coast
Labrador Duck	1875	Atlantic Coast
Dusky Seaside Sparrow	1987	Florida
Laysan Millerbird	1920	Hawaii
Spotless Crake	1944	Hawaii
Apapane	1925	Hawaii
Kauai Akioloa	1965	Hawaii
Kauai Nukupuus	1965	Hawaii
Sandwich Rail	1884	Hawaii
Kioea	1860	Hawaii
Hawaiian Oo	1934	Hawaii
Great Amakihi	1900	Hawaii
Hawaiian Akioloa	1940	Hawaii
Greater Koa Finch	1896	Hawaii
Lesser Koa Finch	1891	Hawaii
Kona Finch	1894	Hawaii
Ula-Ai-Hawane	1892	Hawaii
Mamo	1898	Hawaii
Oahu Omao	1825	Hawaii
Oahu Oo	1837	Hawaii
Oahu Akepa	1900	Hawaii
Oahu Akioloa	1840	Hawaii
Oahu Nukupuus	1890	Hawaii
Lanai Omao	1936	Hawaii
Lanai Alauwahios	1937	Hawaii
Lanai Akioloa	1894	Hawaii
Molokai Omao	1936	Hawaii
Molokai Oo	1904	Hawaii
Molokai Alauwahios	1970	Hawaii
Black Mamo	1907	Hawaii
Maui Nukupuus	1896	Hawaii
MAMMALS		
Newfoundland White Wolf	1911	Newfoundland
Kenai Wolf	1910	Alaska
Texas Grey Wolf	1945	Texas
Great Plains Lobo Wolf	1926	Great Plains
South Rocky Mountains Wolf	1945	Rocky Mountains
Florida Black Wolf	1917	SE United States
Texas Red Wolf	1970	Texas
Florida Red Wolf	1930	Southeast
Mogollon Mountain Wolf	1940	Southwest
Plains Wolf	1926	Great Plains
Amargosa Meadow Vole	1917	California
Gull Island Vole	1898	New York
Wisconsin Cougar	1930	Central States
Steller's Sea Cow	1768	Aleutian Islands
Eastern Elk	1880	Great Plains and East
Merriam Elk	1900	Arizona
Eastern Bison	1825	Eastern States
Oregon Bison	1850	Oregon, Idaho and California
Sea Mink	1880	New England
Badlands Bighorn Sheep	1925	Dakotas and Nebraska
Dawson's Caribou	1908	Canada
Arizona Jaguar	1905	Southwestern States
PLANTS		
Hau Kuahiwi	1912	Hawaii

SYMBOLS OF BIOLOGICAL DIVERSITY

TEAM MEMBERS: _____

STATE: _____

SYMBOL: _____

YEAR SELECTED: _____

What other species were considered: _____

Description: _____

_____

_____

Where it's found: _____

_____

Threatened or Endangered? _____

If so, what are chief threats? _____

_____

_____

Uses by early people: _____

_____

_____

What is your opinion of this species as a state representative? _____

_____

_____